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## (54) Novel fibrinogen receptor antagonists

Fibrinogen-Rezeptor-Antagonisten

Antagonistes de récepteur du fibrinogène

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March 1989, AULENDORF DE pages 328 - 334; I.  
SETNIKAR ET AL: 'METABOLISM AND  
EXCRETION OF 14-C-TIROPAMIDE AFTER  
SINGLE INTRAVENOUS OR PERORAL  
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1819; I. SETNIKAR: 'TIROPAMIDE AND  
METABOLITES IN BLOOD AND PLASMA AFTER  
INTRAVENOUS OR PERORAL ADMINISTRATION  
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## Description

The present invention provides novel compounds, novel compositions, methods of their use and methods of their manufacture, such compounds being generally pharmacologically useful as anti-platelet aggregation agents in various vascular pathologies. The aforementioned pharmacologic activities are useful in the treatment of mammals. More specifically, the compounds of the present invention act by blocking the platelet receptor site of the protein fibrinogen. Fibrinogen is a glycoprotein that circulates in the blood plasma, and whose platelet receptor site is glycoprotein IIb/IIIa. By blocking the action of fibrinogen at the receptor (glycoprotein IIb/IIIa), the compounds of the present invention interfere with platelet aggregation, which is a cause of many vascular pathologies. At the present time, there is a need in the area of vascular therapeutics for such a fibrinogen receptor blocking agent. By interfering with hemostasis, such therapy would decrease the morbidity and mortality of thrombotic disease.

Hemostasis is the spontaneous process of stopping bleeding from damaged blood vessels. Precapillary vessels contract immediately when cut. Within seconds, thrombocytes, or blood platelets, are bound to the exposed matrix of the injured vessel by a process called platelet adhesion. Platelets also stick to each other in a phenomenon known as platelet aggregation to form a platelet plug. This platelet plug can stop bleeding quickly, but it must be reinforced by the protein fibrin for long-term effectiveness, until the blood vessel tear can be permanently repaired by growth of fibroblasts, which are specialized tissue repair cells.

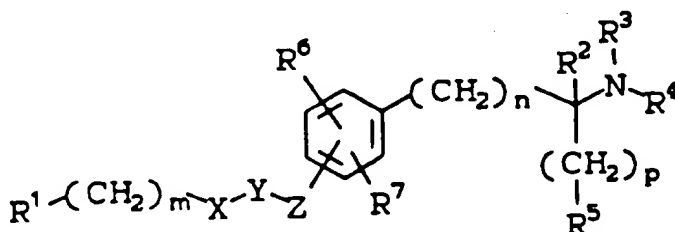
An intravascular thrombus (clot) results from a pathological disturbance of hemostasis. The thrombus can grow to sufficient size to block off arterial blood vessels. Thrombi can also form in areas of stasis or slow blood flow in veins. Venous thrombi can easily detach portions of themselves called emboli that travel through the circulatory system and can result in blockade of other vessels, such as pulmonary arteries. Thus, arterial thrombi cause serious disease by local blockade, whereas venous thrombi do so primarily by distant blockade, or embolization. These diseases include venous thrombosis, thrombophlebitis, arterial embolism, coronary and cerebral arterial thrombosis, myocardial infarction, stroke, cerebral embolism, kidney embolisms and pulmonary embolisms.

There is a need in the area of cardiovascular and cerebrovascular therapeutics for an agent which can be used in the prevention and treatment of thrombi, with minimal side effects, including unwanted prolongation of bleeding in other parts of the circulation while preventing or treating target thrombi. The compounds of the present invention meet this need in the art by providing therapeutic agents for the prevention and treatment of thrombi.

The compounds of the present invention show efficacy as antithrombotic agents by virtue of their ability to block fibrinogen from acting at its platelet receptor site, and thus prevent platelet aggregation.

## SUMMARY OF THE INVENTION

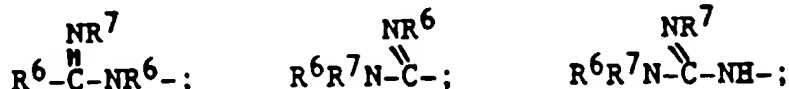
The present invention relates to novel compounds having the general structural formula I:

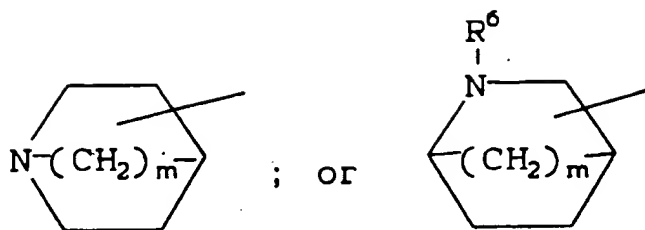


I

and the pharmaceutically acceptable salts thereof, wherein

R<sup>1</sup> is a four to eight member heterocyclic ring containing 1, 2, 3 or 4 hetero atoms wherein said heteroatoms are N, O or S and wherein said heterocyclic ring is optionally substituted at any atom by H, R<sup>6</sup> or R<sup>7</sup>;



NR<sup>6</sup>R<sup>7</sup>wherein R<sup>6</sup> and R<sup>7</sup> are independently hydrogen,

C<sub>1-10</sub> alkoxycarbonyl or unsubstituted or substituted C<sub>1-10</sub> alkyl and cycloalkyl wherein said substituents are

20 C<sub>1-10</sub> alkoxy,  
 C<sub>1-10</sub> alkoxyalkyl,  
 C<sub>1-10</sub> alkoxyalkyloxy,  
 C<sub>1-10</sub> alkoxycarbonyl,  
 C<sub>1-10</sub> alkylcarbonyl,  
 25 C<sub>0-6</sub> alkylaminocarbonyl,  
 C<sub>1-10</sub> aralkylcarbonyl,  
 C<sub>1-10</sub> alkylthiocarbonyl,  
 C<sub>4-10</sub> aralkylthiocarbonyl, thiocarbonyl,  
 C<sub>1-10</sub> alkoxythiocarbonyl, aryl,

30 5 to 6 membered saturated heterocyclic rings of 1, 2, 3 or 4 hetero atoms wherein said hetero atoms are taken from the group consisting of N, O and S,

C<sub>1-4</sub> alkanoylamino,  
 C<sub>1-6</sub> alkoxycarbonyl-C<sub>0-6</sub> alkylamino,  
 C<sub>1-10</sub> alkylsulfonylamino,  
 35 C<sub>4-10</sub> aralkylsulfonylamino,  
 C<sub>4-10</sub> aralkyl,  
 C<sub>1-10</sub> alkaryl,  
 C<sub>1-10</sub> alkylthio,  
 C<sub>4-10</sub> aralkylthio,  
 40 C<sub>1-10</sub> alkylsulfinyl,  
 C<sub>4-10</sub> aralkylsulfinyl,  
 C<sub>1-10</sub> alkylsulfonyl,  
 C<sub>4-10</sub> aralkylsulfonyl,  
 aminosulfonyl,  
 45 C<sub>1-10</sub> alkylaminosulfonyl,  
 C<sub>4-10</sub> aralkylsulfonylamino,  
 oxo,  
 thio,

50 unsubstituted or mono- or di-substituted 1-ethenyl, 2-ethenyl or 3-propenyl wherein said substituents are selected from the group consisting of hydrogen, C<sub>1-10</sub> alkyl and C<sub>7-10</sub>

aralkyl,  
 carboxy,  
 hydroxy,  
 amino,

55 C<sub>1-6</sub> alkylamino,  
 C<sub>1-6</sub> dialkylamino,  
 halogen, where halogen is defined as  
 Cl, F, Br, or I,  
 nitro, or

cyano,  
and further wherein said N can additionally be substituted to form a quaternary ammonium ion wherein said substituent is as previously defined for R<sup>6</sup> and R<sup>7</sup>;

5 R<sup>2</sup> and R<sup>3</sup> are independently  
hydrogen,  
aryl or  
unsubstituted or substituted C<sub>0-10</sub> alkyl or cycloalkyl wherein said substituent is  
C<sub>1-10</sub> alkoxyalkyl,  
10 aryl,  
a 4 to 8 membered heterocyclic ring containing 1, 2, 3 or 4 hetero atoms, wherein said heteroatoms are taken from the group consisting of N, O and S,  
C<sub>4-10</sub> aralkyl,  
C<sub>1-10</sub> alkaryl,  
15 carboxy,  
C<sub>1-10</sub> alkylcarbonyl,  
C<sub>1-10</sub> alkylthiocarbonyl,  
C<sub>4-10</sub> aralkylcarbonyl,  
C<sub>4-10</sub> aralkylthiocarbonyl,  
20 C<sub>1-6</sub> alkoxyalkyl,  
C<sub>4-10</sub> aralkoxyalkyl,  
C<sub>1-6</sub> alkoxy,  
C<sub>4-10</sub> aralkoxy,  
C<sub>1-6</sub> alkylamino,  
25 C<sub>1-12</sub> dialkylamino,  
C<sub>1-6</sub> alkanoylamino,  
C<sub>4-12</sub> aralkanoylamino,  
C<sub>4-10</sub> aralkylamino;

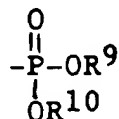
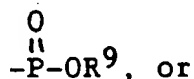
30 R<sup>4</sup> is hydrogen,  
aryl,  
C<sub>1-10</sub> alkyl or cycloalkyl  
C<sub>4-10</sub> aralkyl,  
arylcarbonyl, aminocarbonyl,  
35 C<sub>1-10</sub> alkylcarbonyl, C<sub>1-6</sub> alkylaminocarbonyl,  
C<sub>1-10</sub> alkylthiocarbonyl, C<sub>1-6</sub> dialkylaminocarbonyl,  
C<sub>1-10</sub> alkoxythiocarbonyl, arylC<sub>1-6</sub> alkylaminocarbonyl,  
C<sub>1-10</sub> alkoxyalkyl,  
C<sub>4-10</sub> aralkylcarbonyl,  
40 C<sub>4-10</sub> aralkoxyalkyl,  
C<sub>1-10</sub> carboxyalkyl and  
further wherein any of the substituents for R<sup>4</sup> may be substituted by one or more substituents selected from the group as defined for R<sup>6</sup>, or an L- or D-amino acid joined by an amide linkage;

45 R<sup>5</sup> is  
a four to eight membered saturated or unsaturated heterocyclic ring containing 1, 2, 3 or 4 hetero atoms wherein said hetero atoms are N, O, or S or,



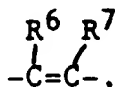
55 wherein R<sup>8</sup> is  
hydroxy,  
C<sub>1-10</sub> alkyloxy,  
C<sub>1-10</sub> alkaryloxy,  
C<sub>4-10</sub> aralkyloxy,  
C<sub>4-10</sub> aralkylcarbonyloxy,

$C_{1-10}$  alkoxyalkyloxy,  
 $C_{1-10}$  alkoxyalkylcarbonyloxy,  
 $C_{1-10}$  alkoxyalkylcarbonyloxyalkyl,  
 $C_{1-10}$  alkylcarbonyloxyalkyloxy,  
 an L- or D-amino acid joined by an amide linkage, and wherein the carboxylic acid moiety of said amino acid is as the free acid or is esterified by  $C_{1-6}$  alkyl.



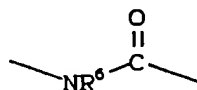
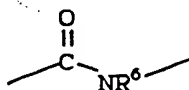
wherein  $R^9$  and  $R^{10}$  are selected from the group consisting of hydrogen,  $C_{1-10}$  alkyl and  $C_{4-10}$  aralkyl;

X and Y are optional substituents that, when present, are  $\text{NR}^6$ ,  
 O,  
 S,  
 SO,  
 SO<sub>2</sub>,



$-\text{C}=\text{C}-$ ,  
 oxo,  
 aryl,  
 thiono,

unsubstituted or substituted  $C_{1-15}$  alkyl or cycloalkyl wherein said substituents are independently  $R^6$  and  $R^7$ ,



$-\text{NR}^6\text{SO}_2$ ,  $-\text{SO}_2\text{NR}^6$ , or

a 4- to 8- membered heterocyclic ring containing 1, 2, 3, or 4 heteroatoms wherein said atoms are N, O, or S and wherein said ring is independently substituted at any atom with  $R^8$ ;

Z is an optional substituent that, when present, is independently chosen as defined by X and Y;

m is an integer of from zero to ten;

n is an integer of from zero to ten; and

p is an integer of from zero to three;

with the exception of:

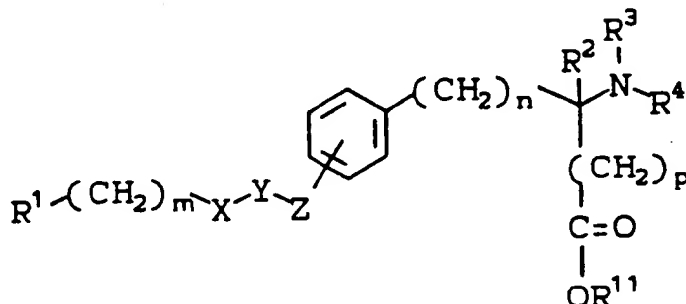
N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine;

N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine;

N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminoethyl)-L-tyrosine; and

5  $\alpha$ -benzoylamino-4-(2-diethylaminoethoxy)benzenepropanoic acid.

A preferred group of compounds of the present invention are those defined for general structural formula II as:



II

25 wherein

R¹ is

a five to six membered heterocyclic ring wherein said heteroatoms are N, O, or S, and wherein said heterocyclic ring is optionally substituted by hydrogen, C₁-₅ alkyl; or

30 NR⁶R⁷ wherein R⁶ and R⁷ are independently hydrogen, unsubstituted or substituted C₁-₁₀ alkyl or C₄-₁₀ aralkyl wherein said substituents are chosen from

C₁-₁₀ alkoxycarbonyl,

aryl,

C₀-₅ dialkylamino C₁-₁₀ alkyl, and

35 C₄-₁₀ aralkyl,

and further wherein said N can additionally be substituted to form a quaternary ammonium ion;

R² and R³ are hydrogen, C₁-₄ alkyl or C₄-₁₀ aralkyl;

40 R⁴

is

H,

C₁-₁₀ alkyl,

C₄-₁₀ aralkyl,

arylcarbonyl,

45 C₁-₁₀ alkylcarbonyl,

C₁-₁₀ alkoxycarbonyl,

C₄-₁₀ aralkylcarbonyl, or

C₄-₁₀ aralkoxycarbonyl,

wherein R⁴ is unsubstituted or substituted with R⁶ as previously defined;

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R¹¹

is

hydrogen or

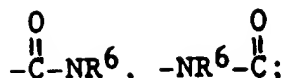
C₁-₁₀ alkyl;

55

X and Y are independently  
O, S, SO, SO<sub>2</sub>,



aryl, -CH=CH-,



-SO<sub>2</sub>NR<sup>6</sup>; -NR<sup>6</sup>SO<sub>2</sub>-, or a 5- or 6- membered heterocyclic ring containing 1 or 2 heteroatoms, wherein said atoms are N, O or S, unsubstituted or substituted C<sub>1-15</sub> straight, branched, or cyclic alkyl wherein said substituent is oxo, hydroxy C<sub>1-4</sub> alkyloxy, or C<sub>4-10</sub> arylalkyl;

Z is an optional substituent that, when present, is O, SO<sub>2</sub>, -NR<sup>6</sup>CO-, -CONR<sup>6</sup>-,



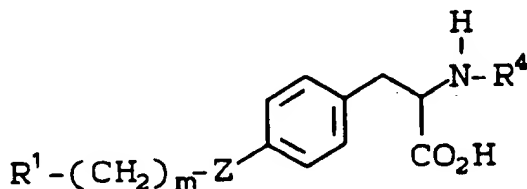
or  
C<sub>1-10</sub> straight or branched alkyl;

m is an integer of from zero to eight;

n is an integer of from zero to two; and

p is an integer of from zero to two.

A more preferred group of compounds of the present invention are those defined for the general structural formula  
III as



wherein

R<sup>1</sup> is a five or 6-membered heterocyclic ring wherein said heteroatom is N and wherein said heterocyclic ring is optionally substituted by hydrogen or C<sub>1-5</sub> alkyl, or NR<sup>6</sup>R<sup>7</sup> wherein R<sup>6</sup> and R<sup>7</sup> are independently hydrogen, C<sub>1-10</sub> alkyl or C<sub>4-10</sub> arylalkyl;

R<sup>4</sup> is  
arylcarbonyl,  
C<sub>1-10</sub> alkylcarbonyl,  
C<sub>1-10</sub> alkoxy carbonyl,  
C<sub>4-10</sub> aralkylcarbonyl,  
C<sub>4-10</sub> aralkoxy carbonyl wherein R<sup>4</sup> is unsubstituted or substituted with R<sup>6</sup> as previously defined;

Z is chosen from:  
O, -NR<sup>6</sup>CO-, -CONR<sup>6</sup>-, or CH<sub>2</sub>; and

m is an integer of from one to six

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#### DETAILED DESCRIPTION OF THE INVENTION

The term "pharmaceutically acceptable salts" shall mean non-toxic salts of the compounds of this invention which are generally prepared by reacting the free base with a suitable organic or inorganic acid. Representative salts include the following salts:

10

Acetate  
Benzenesulfonate  
Benzoate  
Bicarbonate  
Bisulfate  
Bitartrate  
Borate  
Bromide  
Calcium Edetate  
Camsylate  
Carbonate  
Chloride  
Clavulanate  
Citrate  
Dihydrochloride  
Edetate  
Edisylate  
Estolate  
Esylate  
Fumarate  
Glucaptate  
Glucinate  
Glutamate  
Glycolylarsanilate  
Hexylresorcinate  
Hydrabamine  
Hydrobromide  
Hydrochloride  
Hydroxynaphthoate  
Iodide  
Isothionate  
Lactate  
Lactobionate  
Laurate  
Malate  
Maleate  
Mandelate  
Mesylate  
Methylbromide  
Methylnitrate  
Methylsulfate  
Mucate  
Napsylate  
Nitrate  
Oleate  
Oxalate  
Pamaote  
Palmitate  
Pantothenate

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Phosphate/diphosphate  
 Polygalacturonate  
 Salicylate  
 Stearate  
 Subacetate  
 Succinate  
 Tannate  
 Tartrate  
 Teoclate  
 Tosylate  
 Triethiodide  
 Valerate

The term "pharmacologically effective amount" shall mean that amount of a drug or pharmaceutical agent that will elicit the biological or medical response of a tissue, system or animal that is being sought by a researcher or clinician.

The term "anti-coagulant" shall include heparin, and warfarin. The term "thrombolytic agent" shall include streptokinase and tissue plasminogen activator. The term "platelet anti-aggregation agent" shall include aspirin and dipyridimole.

The term "aryl" shall mean a mono- or polycyclic system composed of 5- and 6- membered aromatic rings containing 0, 1, 2, 3 or 4 heteroatoms chosen from N, O or S and either unsubstituted or substituted with R<sup>6</sup>.

The term "alkyl" shall mean straight or branched chain alkane, alkene or alkyne.

The term "alkoxy" shall be taken to include an alkyl portion where alkyl is as defined above.

The terms "aralkyl" and "alkaryl" shall be taken to include an alkyl portion where alkyl is as defined above and to include an aryl portion where aryl is as defined above.

The term "halogen" shall include fluorine, chlorine, iodine and bromine.

The term "oxo" shall mean the radical =O.

The term "thio" shall mean the radical =S.

In the schemes and examples below, various reagent symbols have the following meanings:

BOC:	t-butyloxycarbonyl.
Pd-C:	Palladium on activated carbon catalyst.
DMF:	Dimethylformamide.
DMSO:	Dimethylsulfoxide.
CBZ:	Carbobenzyloxy
CH <sub>2</sub> Cl <sub>2</sub> :	methylene chloride
CHCl <sub>3</sub> :	chloroform
EtOH:	ethanol
MeOH:	Methanol
EtOAc:	ethylacetate
HOAc:	acetic acid
BOP:	Benzotriazol-1-yloxytris(dimethylamino)phosphonium, hexafluorophosphate

The compounds of the present invention can be administered in such oral dosage forms as tablets, capsules (each of which includes sustained release or timed release formulations), pills, powders, granules, elixers, tinctures, suspensions, syrups and emulsions. Likewise, they may also be administered in intravenous (bolus or infusion), intra-peritoneal, subcutaneous or intramuscular form, all using forms well known to those of ordinary skill in the pharmaceutical arts. An effective but non-toxic amount of the compound desired can be employed as an anti-aggregation agent.

Compounds of the invention may be administered to patients where prevention of thrombosis by inhibiting binding of fibrinogen to the platelet membrane glycoprotein complex IIb/IIIa receptor is desired. They are useful in surgery on peripheral arteries (arterial grafts, carotid endarterectomy) and in cardiovascular surgery where manipulation of arteries and organs, and/or the interaction of platelets with artificial surfaces, leads to platelet aggregation and consumption.

The aggregated platelets may form thrombi and thromboemboli. They may be administered to these surgical patients to prevent the formation of thrombi and thromboemboli.

Extracorporeal circulation is routinely used for cardiovascular surgery in order to oxygenate blood. Platelets adhere to surfaces of the extracorporeal circuit. Adhesion is dependent on the interaction between GPIIb/IIIa on the platelet membranes and fibrinogen adsorbed to the surface of the circuit. (Gluszko et al., *Amer. J. Physiol.*, 1987, 252:H, pp 615-621). Platelets released from artificial surfaces show impaired hemostatic function. Compounds of the invention may be administered to prevent adhesion.

Other applications of these compounds include prevention of platelet thrombosis, thromboembolism and reocclusion during and after thrombolytic therapy and prevention of platelet thrombosis, thromboembolism and reocclusion after

angioplasty of coronary and other arteries and after coronary artery bypass procedures. They may also be used to prevent myocardial infarction.

The dosage regimen utilizing the compounds of the present invention is selected in accordance with a variety of factors including type, species, age, weight, sex and medical condition of the patient; the severity of the condition to be treated; the route of administration; the renal and hepatic function of the patient; and the particular compound or salt thereof employed. An ordinarily skilled physician or veterinarian can readily determine and prescribe the effective amount of the drug required to prevent, counter or arrest the progress of the condition.

Oral dosages of the present invention, when used for the indicated effects, will range between about 0.01 mg per kg of body weight per day (mg/kg/day) to about 100 mg/kg/day and preferably 1.0-100 mg/kg/day and most preferably 1.0 to 20 mg/kg/day. Intravenously, the most preferred doses will range from about 1 to about 10 mg/kg/minute during a constant rate infusion. Advantageously, compounds of the present invention may be administered in a single daily dose, or the total daily dosage may be administered in divided doses of two, three or four times daily. Furthermore, preferred compounds for the present invention can be administered in intranasal form via topical use of suitable intranasal vehicles, or via transdermal routes, using those forms of transdermal skin patches well known to those of ordinary skill in that art. To be administered in the form of a transdermal delivery system, the dosage administration will, of course, be continuous rather than intermittent throughout the dosage regimen.

In the methods of the present invention, the compounds herein described in detail can form the active ingredient, and are typically administered in admixture with suitable pharmaceutical diluents, excipients or carriers (collectively referred to herein as 'carrier' materials) suitably selected with respect to the intended form of administration, that is, oral tablets, capsules, elixirs, syrups and the like, and consistent with conventional pharmaceutical practices.

For instance, for oral administration in the form of a tablet or capsule, the active drug component can be combined with an oral, non-toxic, pharmaceutically acceptable, inert carrier such as lactose, starch, sucrose, glucose, methyl cellulose, magnesium stearate, dicalcium phosphate, calcium sulfate, mannitol, sorbitol and the like; for oral administration in liquid form, the oral drug components can be combined with any oral, non-toxic, pharmaceutically acceptable inert carrier such as ethanol, glycerol, water and the like. Moreover, when desired or necessary, suitable binders, lubricants, disintegrating agents and coloring agents can also be incorporated into the mixture. Suitable binders include starch, gelatin, natural sugars such as glucose or beta-lactose, corn sweeteners, natural and synthetic gums such as acacia, tragacanth or sodium alginate, carboxymethylcellulose, polyethylene glycol, waxes and the like. Lubricants used in these dosage forms include sodium oleate, sodium stearate, magnesium stearate, sodium benzoate, sodium acetate, sodium chloride and the like. Disintegrators include, without limitation, starch, methyl cellulose, agar, bentonite, xanthan gum and the like.

The compounds of the present invention can also be administered in the form of liposome delivery systems, such as small unilamellar vesicles, large unilamellar vesicles and multilamellar vesicles. Liposomes can be formed from a variety of phospholipids, such as cholesterol, stearylamine or phosphatidylcholines.

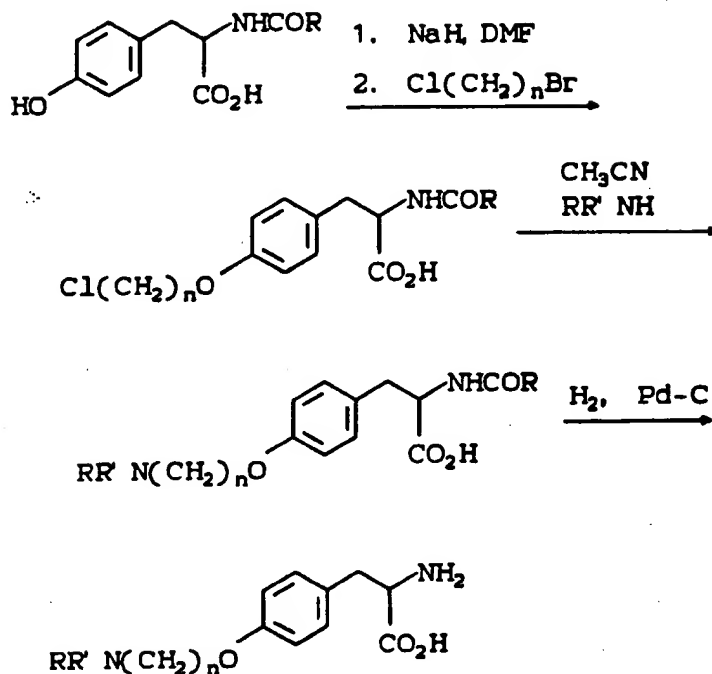
Compounds of the present invention may also be delivered by the use of monoclonal antibodies as individual carriers to which the compound molecules are coupled. The compounds of the present invention may also be coupled with soluble polymers as targetable drug carriers. Such polymers can include polyvinylpyrrolidone, pyran copolymer, polyhydroxypropylmethacrylamide-phenol, polyhydroxyethylaspartamide-phenol, or polyethyleneoxide-polylysine substituted with palmitoyl residues. Furthermore, the compounds of the present invention may be coupled to a class of biodegradable polymers useful in achieving controlled release of a drug, for example, polylactic acid, polyglycolic acid, copolymers of polylactic and polyglycolic acid, polyepsilon caprolactone, polyhydroxy butyric acid, polyorthoesters, polyacetals, polydihydropyrans, polycyanoacrylates and cross-linked or amphipathic block copolymers of hydrogels.

The compounds of the present invention can also be co-administered with suitable anti-coagulant agents or thrombolytic agents such as plasminogen activators or streptokinase to achieve synergistic effects in the treatment of various vascular pathologies. They may also be combined with heparin, aspirin or warfarin.

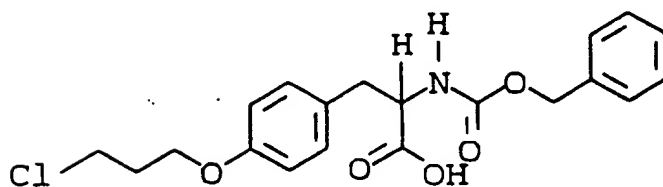
The novel compounds of the present invention were prepared according to the procedure of the following schemes and examples, using appropriate materials and are further exemplified by the following specific examples. The most preferred compounds of the invention are any or all of those specifically set forth in these examples. These compounds are not, however, to be construed as forming the only genus that is considered as the invention, and any combination of the compounds or their moieties may itself form a genus. The following examples further illustrate details for the preparation of the compounds of the present invention. Those skilled in the art will readily understand that known variations of the conditions and processes of the following preparative procedures can be used to prepare these compounds.

All temperatures are degrees Celsius unless otherwise noted.

# SCHEME 1



## EXAMPLE 1



### 2-S-(N-Benzyloxycarbonylamino)-3-[4-(3-chloropropoxy)phenyl]propionic acid (1-1)

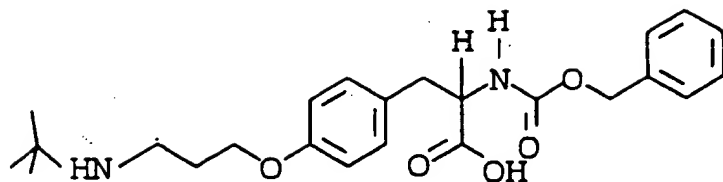
N-CBZ-tyrosine (3 g, 9.9 mmole) (from Bachem Chemical Supply, California), was dissolved in DMF and treated with NaH (50% dispersion in oil, 0.95 g, 19.8 mmole) for 1 hour, then 1,3 bromochloropropane (1 ml, 9.9 mmole) was added and the reaction stirred for 16 hours. The DMF was removed in vacuo and the residue dissolved in water, acidified to pH 3, and extracted with ethyl acetate. The ethyl acetate layer was dried with MgSO<sub>4</sub>, filtered and evaporated. Column chromatography (SiO<sub>2</sub>, 97:3:1 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc) yielded 2.42 g of product as a yellow oil.

RF = 0.3 in 97:3:1 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc ninhydrin stain

300 MHz <sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.3 (bs, 5H),

7.03 (d, J = 8.3, 2H), 6.8 (d, J = 8.3, 2H), 5.2 (d, J = 8Hz, 1H), 5.05 (bs, 2H) 4.65 (m, 1H), 4.05 (t, J = 5.7 Hz, 2H), 3.73 (t, J = 6.3 Hz, 2H), 3.1 (m, 2H), 2.2 (m, 2H).

## EXAMPLE 2

2-S-(Benzyloxycarbonylamino)-[4-(3-t-butylaminopropoxy)phenyl]propionic acid (1-2)

Compound 1-1 (0.4 g, 1.1 mmole) was refluxed in t-butylamine (20 ml) and acetonitrile (20 mL) for three days. The reaction was evaporated to dryness, the residue dissolved in water, and extracted with ether. The aqueous layer was then acidified to pH 4-5 and a precipitate formed. The solid was collected and dried to yield 70 mg of product.

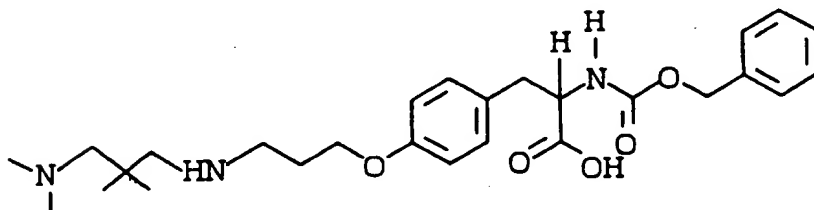
R<sub>f</sub> = 0.8 in 9:1 EtOH/NH<sub>4</sub>OH, ninhydrin stain.

300 MHz <sup>1</sup>H NMR (D<sub>2</sub>O + NaOH) δ 7.4 (bs, 2H), 7.2 (bs, 4H), 6.85 (d, J = 8.55, 2H), 5.2 (d, J = 12.8 Hz, 1H), 5.0 (d, J = 12.8 Hz, 1H), 4.3 (dd, J = 4.0, 9.6 Hz, 1H), 4.0 (bs, 2H), 3.2 (dd, J = 4.0, 13.6 Hz, 1H), 2.8 (dd, J = 9.6 Hz, 13.6 Hz, 1H), 2.65 (t, J = 7.3 Hz, 2H), 1.8 (m, 2H), 1.09 (s, 9H), mass spec (FAB) m/e = 429 (m + 1)

C, H, N analysis C<sub>24</sub>H<sub>32</sub>N<sub>2</sub>O<sub>5</sub> 0.65 H<sub>2</sub>O

MW = 440.244	Calculated	C = 65.47,	H = 7.62,	N = 6.36
	Found	C = 65.52,	H = 7.54,	N = 6.27

## EXAMPLE 3

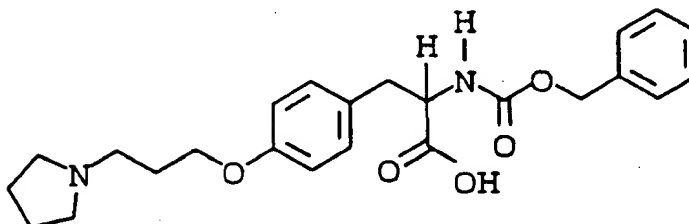
2-S-(N-Benzyloxycarbonylamino)-3-[4-(N,N,2,2-tetramethylpropanediamino)propoxyphenyl]propionic acid (1-3)

Treatment of compound 1-1 with excess N,N,2,2-tetramethyl-1,3-propanediamine by refluxing in acetonitrile for three days, and followed by an aqueous workup provided crude 1-3. This was chromatographed on silica gel eluting with 9:1:1 EtOH/H<sub>2</sub>O/NH<sub>4</sub>OH to provide pure 1-3 (R<sub>f</sub> = 0.37 ninhydrin stain). 300 MHz <sup>1</sup>H NMR (D<sub>2</sub>O) δ 7.5 (bs, 3H), 7.4 (bs, 2H), 7.33 (d, J = 8.3Hz, 2H), 7.0 (d, J = 8.3Hz, 2H), 5.20 (d, J = 10Hz, 1H), 5.10 (d, J = 10Hz, 1H), 4.25 (m, 1H), 4.25 (t, J =

5.6Hz, 2H), 3.4 (t, J = 7.8Hz, 2H), 3.4 (s, 2H), 3.25-2.95 (m, 2H), 3.22 (s, 2H), 3.1 (s, 6H), 2.35 (m, 2H), 1.38 (s, 6H).

MW = 759.28			
C, H, N analysis for $C_{27}H_{39}N_2O_5 \cdot 2.4 C_2HF_3O_2$			
Calcd:	C, 50.30;	H, 5.50;	N, 5.53.
Found:	C, 50.35;	H, 5.43;	N, 5.56.

#### EXAMPLE 4

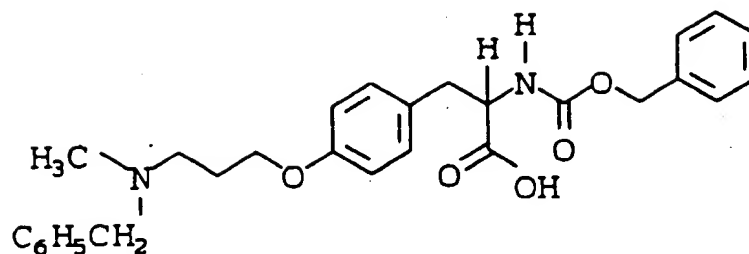


#### 2-S-(N-Benzyloxycarbonylamino)-3-[4-(3-N-pyrrolidinylpropyloxy)phenyl]propionic acid (1-4)

Treatment of compound 1-1 with excess pyrrolidine in  $CH_3CN$  at reflux for three days provided crude 1-4. This was purified by flash chromatography on silica gel eluting with 9:1:1 EtOH/ $H_2O$ / $NH_4OH$  to give pure 1-4 ( $R_f$  = 0.81, ninhydrin stain) in 36% yield. 300 MHz  $^1H$  NMR ( $CDCl_3$ )  $\delta$  7.3 (bs, 5H), 7.0 (d, J = 8.1Hz, 2H), 6.7 (d, J = 8.1Hz, 2H), 5.5 (d, J = 7.4Hz, 1H), 5.0 (bs, 2H), 4.5 (m, 1H), 3.8 (m, 2H), 3.75 (bs, 1H), 3.4 (m, 2H), 3.18 (t, J = 8.5Hz, 2H), 3.1 (bs, 2H), 2.8 (bs, 1H), 2.2-1.8 (m, 6H).

C, H, N analysis $C_{24}H_{30}N_2O_5 \cdot 0.25 CH_2Cl_2$			
Calcd:	C, 65.05;	H, 6.87;	N, 6.26.
Found:	C, 65.28;	H, 6.78;	N, 6.27.

## EXAMPLE 5

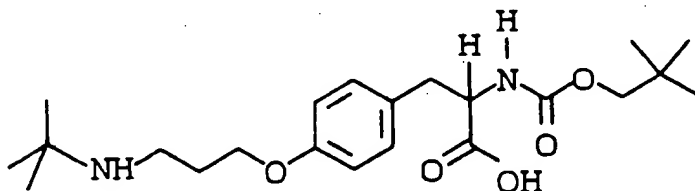


2-S-(N-Benzyloxycarbonylamino)-[4-(3-N-methyl-N-benzylaminopropoxy)phenyl]propionic acid (1-5)

Treatment of 1-1 with excess N-methyl benzylamine in acetonitrile at reflux for three days afforded crude 1-5. The solvent was removed on a rotary evaporator and the residue was dissolved in water and extracted with 3 x 75 mL portions of ether. The product separated out as an oil which was collected and concentrated to give 1-5 (70 mg) as a foam. 300 MHz <sup>1</sup>H NMR (CDCl<sub>3</sub>/CD<sub>3</sub>OD) δ 7.4 (m, 10H), 7.0 (d, J = 8.5Hz, 2H), 6.6 (d, J = 8.5Hz, 2H), 5.0 (bs, 2H), 4.5 (m, 1H), 4.2 (bs, 2H), 3.88 (t, J = 5.3Hz, 2H), 3.1-2.8 (m, 4H), 2.69 (s, 3H), 2.2 (bs, 2H).

C, H, N analysis C <sub>28</sub> H <sub>32</sub> N <sub>2</sub> O <sub>5</sub> ·0.8 CH <sub>2</sub> Cl <sub>2</sub> ·0.25 EtOAc			
Calcd:	C, 63.17;	H, 6.33;	N, 4.94.
Found:	C, 63.16;	H, 6.40;	N, 5.04.
MW = 548.771			

## EXAMPLE 6



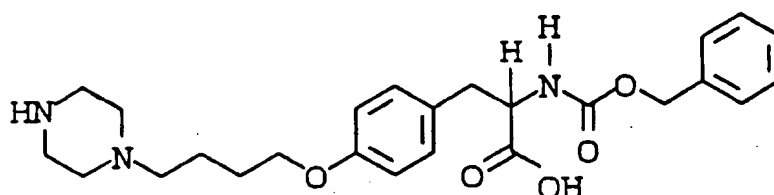
2-S-(N-(t-Butyloxycarbonylamino)-[4-(3-N-t-butylamino propyl-oxy)phenyl]propionic acid (1-6)

Treatment of N-BOC-L-tyrosine with sodium hydride in DMF followed by 1,3-bromochloropropane provided the N-BOC analog of 1-1. This was treated with an excess of t-butylamine in refluxing acetonitrile for two days to provide crude 1-6 after aqueous workup and extraction. Pure 1-6 was prepared by preparative reverse phase HPLC.

300 MHz  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ )  $\delta$  7.17 (d,  $J$  = 8.5 Hz, 2H), 6.85 (d,  $J$  = 8.5 Hz, 2H), 4.28 (dd,  $J$  = 4.8, 9.1 Hz, 1H), 4.1 (t,  $J$  = 5.9 Hz, 2H), 3.2 (t,  $J$  = 7.7 Hz, 2H), 3.1 (dd,  $J$  = 4.8, 13.3 Hz, 1H), 2.8 (dd,  $J$  = 9.1, 13.3 Hz, 1H), 2.15 (m, 2H), 1.38 (s, 18H).

C, H, N analysis $\text{C}_{21}\text{H}_{34}\text{N}_2\text{O}_7 \cdot 1.05 \text{ C}_2\text{HF}_3\text{O}_2$ MW = 514.243			
Calcd:	C, 53.95;	H, 6.87;	N, 5.45.
Found:	C, 54.01;	H, 6.97;	N, 5.51.

# EXAMPLE 7

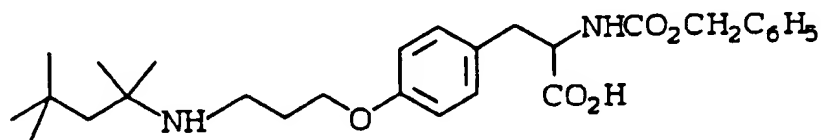


## 2-S-(N-(Benzyloxycarbonylamino)-3-[4-(4-piperazinyl)butyloxyphenyl]propionic acid (1-7)

Treatment of N-CBZ-L-tyrosine with sodium hydride in DMF followed by 1,4-dibromobutane, as described for the preparation of 1-1, provided the corresponding butyl analog. Treatment of this with 1,4-piperazine in refluxing acetonitrile for three days gave crude 1-7 as a precipitate from the reaction mixture. Reverse phase HPLC purification gave pure 1-7. 300 MHz  $^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ )  $\delta$  7.3 (m, 5H), 7.23 (d, 2H), 6.83 (d, 2H), 5.0 (bs, 2H), 4.35 (dd, 1H), 4.0 (t, 2H), 3.6 (bs, 8H), 3.1 (dd, 1H), 2.85 (dd, 1H), 2.00-1.8 (m, 4H).

C, H, N analysis $\text{C}_{26}\text{H}_{35}\text{N}_3\text{O}_5 \cdot 1.2 \text{ H}_2\text{O}$ MW = 491.206			
Calcd:	C, 63.57;	H, 7.67;	N, 8.56.
Found:	C, 63.33;	H, 7.28;	N, 8.55.

# EXAMPLE 7(a)

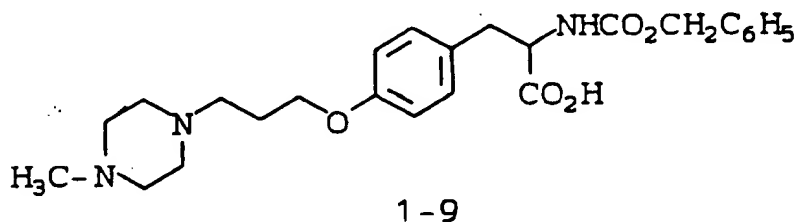


1-8

2-S-(N-(Benzyloxycarbonylamino)-3-[4-(1,1,4,4-tetramethylbutylamino)propyloxyphenyl]propionic acid (1-8)

Treatment of 1-1 with 1,1,4,4-tetramethylbutylamine, as described for compound 1-2, gave 1-8 as the TFA salt. <sup>1</sup>H NMR (300 MHz CD<sub>3</sub>OD) δ 7.35 (5H, m), 7.18 (2H, d), 6.85 (1H, d), 5.00 (2H, s), 4.35 (1H, dd), 4.10 (2H, t), 3.1 (2H, t), 3.15 (1H, dd), 2.50 (1H, dd), 2.1 (2H, m), 1.70 (2H, s), 1.5 (6H, s), 1.10 (9H, s).

Analysis for C <sub>28</sub> H <sub>40</sub> N <sub>2</sub> O <sub>5</sub> ·0.9 C <sub>2</sub> HF <sub>3</sub> O <sub>2</sub>			
Calcd:	C, 60.94;	H, 7.02;	N, 4.77.
Found:	C, 60.85;	H, 7.01;	N, 4.69.

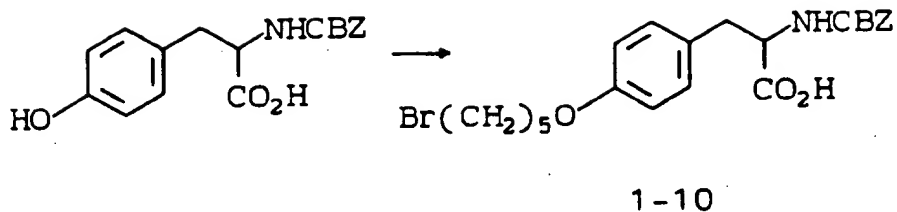
EXAMPLE 7(b)2-S-(N-(Benzyloxycarbonyl)-3-[4-(4-methylpiperazin-1-yl)propyloxyphenyl]propanoic acid (1-9)

Treatment of 1-1 with N-methylpiperazine as described for 1-2 gave crude 1-9. This was purified by column chromatography on silica gel eluting with 9:1:1 C<sub>2</sub>H<sub>5</sub>OH/H<sub>2</sub>O/NH<sub>4</sub>OH to give pure 1-9 as the TFA salt.

<sup>1</sup>H NMR (300 MHz D<sub>2</sub>O) δ 7.5 (3H, m), 7.4 (2H, d), 7.0 (2H, d), 5.18 (1H, d), 5.05 (1H, d), 4.5 (1H, m), 4.2 (2H, t), 3.8 (8H, s), 3.6 (2H, t), 3.3 (1H, m), 3.1 (3H, s), 3.0 (1H, m), 2.4 (2H, m).

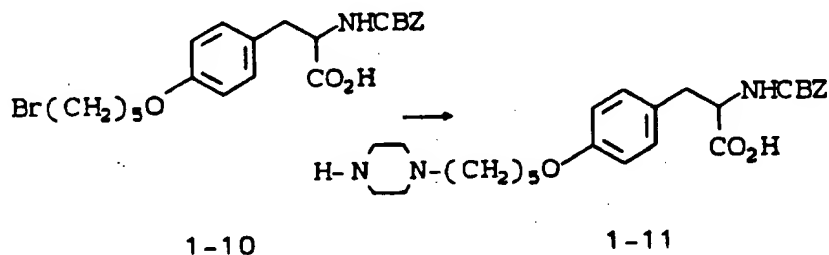
Analysis for C <sub>25</sub> H <sub>33</sub> N <sub>3</sub> O <sub>5</sub> ·2.3 C <sub>2</sub> HF <sub>3</sub> O <sub>2</sub>			
Calcd:	C, 49.52;	H, 4.96;	N, 5.85.
Found:	C, 49.42;	H, 4.98;	N, 6.01.



**EXAMPLE 7(c)****2-(N-(Benzyloxycarbonylamino)-3-[4-(5-bromopentyloxy)phenyl]propionic acid (1-10)**

N-CBZ-L-tyrosine (2.06 g, 5.86 mmole) was treated with NaH (0.58 g, 12.08 mmole) and 1,5-dibromopentane (0.8 ml, 5.87 mmole) as described for 1-1 in Example 1. The crude product was dissolved in methanol and after stirring with silica gel for 0.5 hour, the solvent was removed. This was dry packed and eluted on a flash column with CHCl<sub>3</sub> and then with 97:3:0.3 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc to give pure 1-10 (0.66 g).

<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.50-1.65 (2H, m), 1.63-1.95 (4H, m), 3.10 (2H, m), 3.45 (1H, t), 3.92 (2H, m), 4.40 (1H, m), 6.80 (2H, d), 7.10 (2H, d), 7.28 (5H, m).

**EXAMPLE 7(d)****2-S-(N-(Benzyloxycarbonylamino)-3-[4-(4-piperazin-1-yl)-pentyloxyphenyl]propionic acid (1-11)**

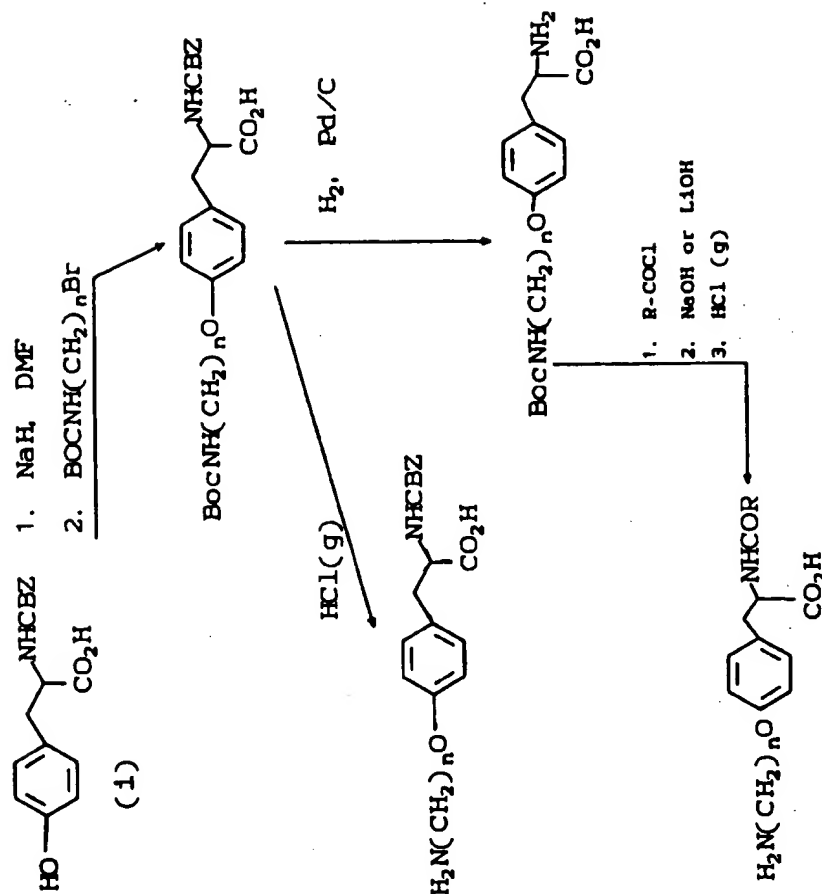
1-10 (0.658 g, 1.42 mmole), was dissolved in 30 mL CH<sub>3</sub>CN and 1,4-piperazine (1.22 g, 14.16 mmole) was added. This solution was stirred at room temperature for 4 days. The solvent was then removed and the residue was dry packed

on a silica gel column and eluted with 18:1:1 C<sub>2</sub>H<sub>5</sub>OH/H<sub>2</sub>O/NH<sub>4</sub>OH to give pure 1-11 (34 mg) as a white solid.

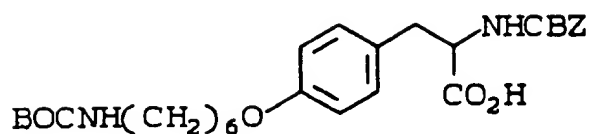
<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.52 (4H, m), 1.77 (2H, m), 2.40 (2H, t), 2.59 (4H, m), 2.80-2.94 (1H, m), 3.01-3.12 (5H, m), 3.94 (2H, m), 4.21 (1H, m), 6.76 (2H, d), 7.09 (2H, d).

Analysis for C <sub>26</sub> H <sub>35</sub> N <sub>3</sub> O <sub>5</sub> ·1.2 H <sub>2</sub> O			
Calcd:	C, 63.57;	H, 7.67;	N, 8.56
Found:	C, 63.33;	H, 7.28;	N, 8.55

SCHEME 2



## EXAMPLE 8

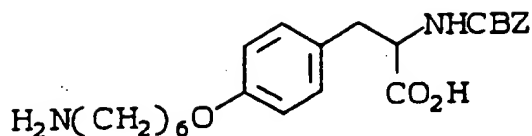


## 2-S-(N-(Benzyloxycarbonylamino)-3-[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propionic acid (2-1)

N-CBZ-L-tyrosine (15.0 g, 0.045 moles) was dissolved in 75 mL DMF and added at 0-10°C to a suspension of sodium hydride (2.16 g, 0.09 moles) in 25 mL DMF. The resulting suspension was stirred at 0-10°C for 1.0 hour and then 6-(t-butyloxycarbonylamino)hexyl bromide (12.6 g, 0.045 moles) in 25 mL DMF was added dropwise at 0-5°C and the clear, dark reaction mixture was stirred at room temperature overnight.

After solvent removal, the residue was taken up in EtOAc and this was made acidic with 10%  $\text{KHSO}_4$  solution. The organic phase was separated, washed with brine, dried ( $\text{Na}_2\text{SO}_4$ ) and the solvent removed to give an oil. This was purified by column chromatography on silica gel eluting with 98:2:1  $\text{CHCl}_3/\text{CH}_3\text{OH}/\text{HOAc}$  to give pure 2-1 as a clear oil.  $^1\text{H}$  NMR (300 MHz,  $\text{CD}_3\text{OD}$ )  $\delta$  1.45 (15H, m), 1.75 (2H, m), 2.80-3.15 (6H, m), 3.91 (2H, t), 4.38 (1H, m), 4.95 (6H, m), 6.79 (2H, d), 7.10 (2H, d), 7.28 (5H, m).

## EXAMPLE 9

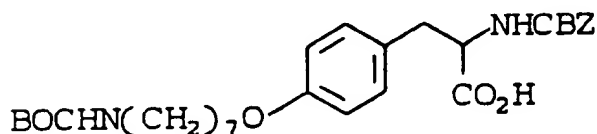
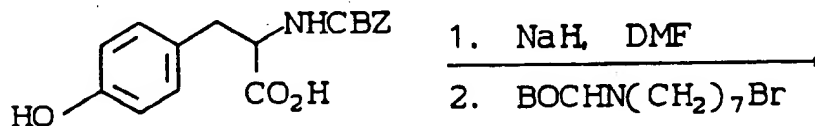
2-S-(N-(Benzyloxycarbonylamino)-3-[4-(6-aminohexyloxyphenyl)]propionic acid hydrochloride (2-2)

Compound 2-1 (51.4 mg, 0.1 mmole) was dissolved in 20 mL EtOAc and cooled to -20°C under N<sub>2</sub>. HCl gas was bubbled into this solution for 10 minutes as the temperature rose to -5°C. The reaction mixture was stoppered and stirred at 0° to -5°C for 1 hour. The solvent was then removed on the rotary evaporator and the residue was triturated with ether to give 2-2 (14.2 mg) as a white solid. R<sub>f</sub> = 0.4 (SiO<sub>2</sub>, 9:1:1 EtOH/NH<sub>4</sub>OH, H<sub>2</sub>O).

<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.45 (6H, m), 1.73 (4H, m), 2.90 (3H, m), 3.13 (1H, m), 3.95 (2H, m), 4.30 (1H, bs), 6.77 (2H, d), 7.10 (2H, d), 7.32 (4H, m).

Analysis for C <sub>23</sub> H <sub>31</sub> N <sub>2</sub> O <sub>5</sub> Cl·0.5 H <sub>2</sub> O			
Calcd:	C, 60.05;	H, 7.01;	N, 6.09
Found:	C, 60.08;	H, 7.06;	N, 6.09

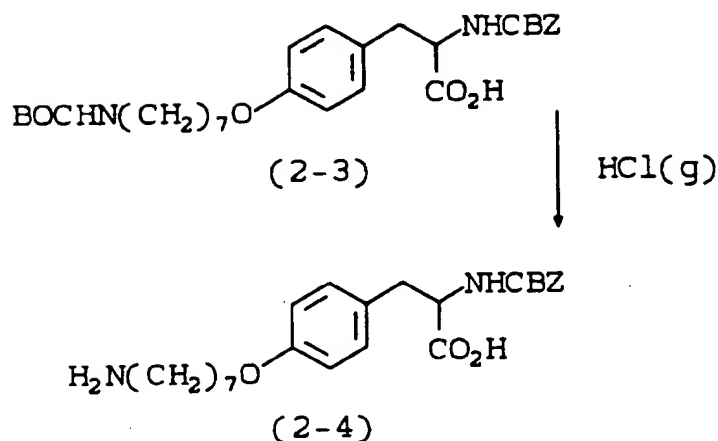
## EXAMPLE 10

2-S-(N-(Benzyloxycarbonylamino)-3-[4-(7-N-t-butyloxycarbonylaminoheptyloxy)phenyl]propionic acid (2-3)

N-CBZ-L-tyrosine (1.27 g, 4.02 mmoles) was alkylated with 7-(N-t-butyloxycarbonylaminoheptyl)bromide as taught in Example 8 for compound 2-1. Crude product was purified by flash chromatography on silica gel eluting with 95:5:0.5 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc to give 1.05 g (50%) of 2-3 as a clear oil.

<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.40 (20H, m), 1.66 (2H, m), 2.82 (1H, m), 2.97-3.18 (4H, m), 3.91 (2H, m), 4.19 (1H, m), 5.0 (2H, q), 6.77 (2H, d), 7.10 (2H, d), 7.30 (5H, m).

## EXAMPLE 11

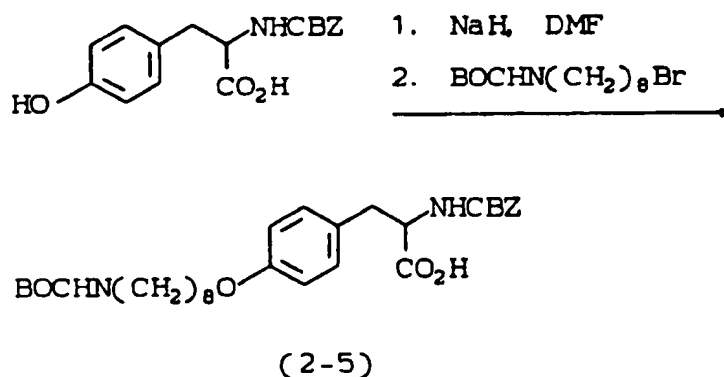
2-S-(N-(Benzyloxycarbonylamino)-3-[4-(7-aminoheptyloxy)phenyl]propionic acid hydrochloride (2-4)

Compound 2-3 (67.4 mg, 0.127 mmole) was deprotected with HCl gas as described in Example 9 for 2-2 to provide 60.0 mg pure 2-4.

$^1\text{H}$  NMR (300 MHz,  $\text{CD}_3\text{OD}$ )  $\delta$  1.32 (9H, m), 1.60 (4H, m), 2.77 (3H, m), 3.00 (1H, m), 3.18 (2H, m), 3.72 (2H, m), 4.25 (1H, m), 4.90 (2H, q), 6.70 (2H, d), 7.00 (2H, d), 7.18 (5H, m).

Analysis for $\text{C}_{24}\text{H}_{32}\text{N}_2\text{O}_5 \cdot 0.2\text{EtOH} \cdot 0.75\text{H}_2\text{O}$			
Calcd:	C, 64.94;	H, 7.75;	N, 6.21
Found:	C, 64.97;	H, 7.84;	N, 6.22

## EXAMPLE 12

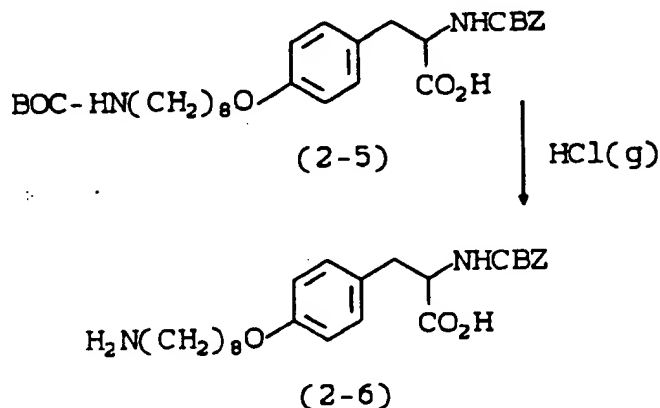
2-S-(N-(Benzyloxycarbonylamino)-3-[4-(8-N-t-butyloxycarbonylamino-octyloxy)phenyl]propionic acid (2-5)

N-CBZ-L-tyrosine· $\text{H}_2\text{O}$  (1.5 g, 4.29 mmole) was dissolved in  $\text{EtOAc}/\text{CH}_2\text{Cl}_2$ , dried over  $\text{MgSO}_4$ , filtered and evaporated. The residue was dissolved in DMF and treated with  $\text{NaH}$  (50% dispersion in oil, 0.43 g, 8.96 mmole) for 1 hour. N-BOC-8-amino-1-bromooctane (1.33 g, 4.34 mmole) was added and the reaction was stirred for 16 hours. The DMF was removed *in vacuo*, the residue dissolved in water, acidified to pH 3 and extracted with  $\text{EtOAc}$ . The  $\text{EtOAc}$  layers

were combined, dried and concentrated. Column chromatography (SiO<sub>2</sub>, 97:3:1 CHCl<sub>3</sub>/MeOH/HOAc) gave 2-5 (1.35 g) (57% yield).

<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 7.3 (m, 5H), 7.1 (d, 2H), 6.78 (d, 2H), 5.0 (2q, 2H), 4.38 (dd, 1H), 3.8 (m, 2H), 3.13 (dd, 1H), 3.0 (t, 2H), 2.85 (dd, 1H), 1.75 (m, 2H), 1.4 (s, 9H), 1.35 (m, 3H), 1.3 (bs, 7H).

### EXAMPLE 13

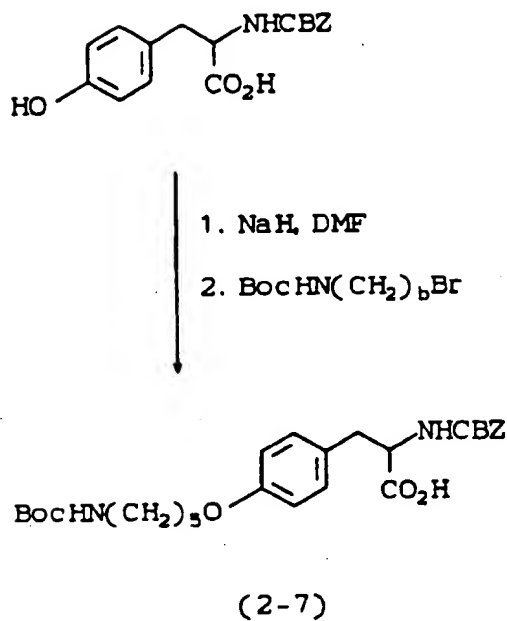


### 2-S-(N-(Benzyloxycarbonylamino)-3-[4-(8-aminooctyloxy)phenyl]propionic acid (2-6)

Compound 2-5 (1.35 g, 2.49 mmole) was dissolved in ethyl acetate and treated with HCl gas at -20°C, purged with N<sub>2</sub> and concentrated to give a white solid which was rinsed with ethyl acetate and dried to give 0.965 g of product.

<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 7.3 (m, 5H), 7.1 (d, 2H), 6.8 (d, 2H), 5.02, (2q, 2H), 4.35 (dd, 1H), 4.03 (t, 2H), 3.1 (dd, 1H), 2.9 (t, 2H), 2.85 (dd, 1H), 1.75 (m, 2H), 1.65 (m, 2H), 1.5 (m, 2H), 1.4 (bs, 6H).

Analysis for C <sub>25</sub> H <sub>34</sub> N <sub>2</sub> O <sub>5</sub> ·HCl·0.65 H <sub>2</sub> O			
MW = 490.732			
Calcd:	C, 61.18;	H, 7.46;	N, 5.71
Found:	C, 61.18;	H, 7.45;	N, 5.77

EXAMPLE 142-S-(N-(Benzyloxycarbonylamino)-3-[4-(5-N-t-butyloxycarbonylaminopentyloxy)phenyl]propionic acid (2-7)

30 N-CBZ-L-tyrosine (1.06 g, 3.01 mmole) was alkylated with 5-N-t-(butyloxycarbonylaminopentyl) bromide as described for compound 2-1 in Example 8. Crude product was purified by flash chromatography on silica gel eluting with 97:3:0.5 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc to give pure 2-7.

<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.42 (9H, s), 1.52 (4H, m), 1.76 (2H, m), 3.05, (3H, m), 3.92 (2H, t), 5.00 (2H, m), 6.79 (2H, d), 7.11 (2H, d), 7.28 (5H, m).

35

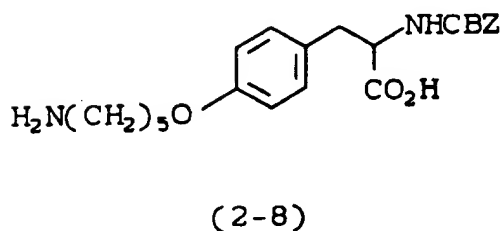
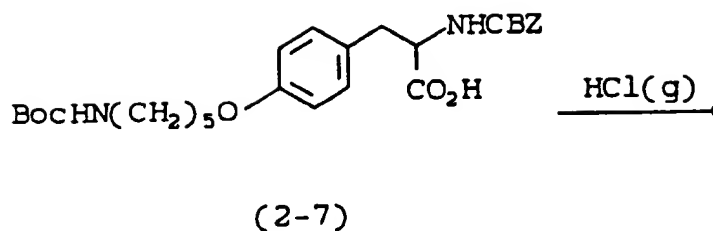
40

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## EXAMPLE 15



## 2-S-(N-(Benzyloxycarbonylamino)-3-[4-(5-amino-pentyloxy)phenyl]propionic acid hydrochloride (2-8)

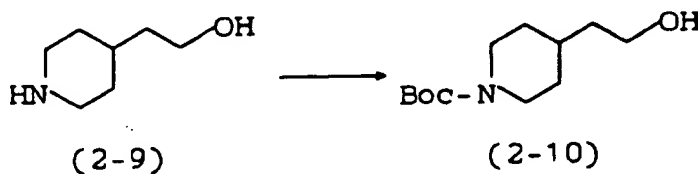
2-7 was treated with HCl gas as taught in Example 9 for compound 2-2, to provide pure 2-8 as a white powder.  
<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.60 (2H, m), 1.77 (4H, m), 2.90 (3H, m), 3.12, (1H, m), 3.96 (2H, t), 4.37 (1H, m), 5.02 (2H, m), 6.81 (2H, d), 7.12 (2H, d), 7.30 (5H, m).

30

Analysis for C <sub>22</sub> H <sub>28</sub> N <sub>2</sub> O <sub>5</sub> ·0.25 H <sub>2</sub> O			
Calcd:	C, 59.85;	H, 6.74;	N, 6.35
Found:	C, 59.85;	H, 6.73;	N, 6.32

35

## EXAMPLE 16



## 2-(4-N-t-Butyloxycarbonylpiperidinyl)ethanol (2-10)

4-piperidine-2-ethanol (Available from American Tokyo Kasei) (130 g, 1.0 mole) was dissolved in 700 mL dioxane, cooled to 0° C and treated with 3 N NaOH (336 mL, 1.0 mole), and di-t-butylcarbonate (221.8 g, 1.0 mole). The ice bath was removed and the reaction stirred overnight. The reaction was concentrated, diluted with water and extracted with ether. The ether layers were combined, washed with brine, dried over MgSO<sub>4</sub>, filtered and evaporated to give 225.8 g of product (98%).

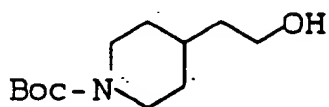
$R_f = 0.37$  in 1:1 EtOAc/Hexanes, ninhydrin stain

300 MHz  $^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  4.07 (bs, 2H), 3.7 (bs, 2H), 2.7 (t,  $J = 12.5$  Hz, 2H), 1.8-1.6 (m, 6H), 1.51 (s, 9H), 1.1 (ddd,  $J = 4.3, 12.5, 12$  Hz, 2H).

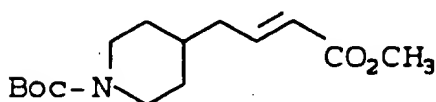
# 5 EXAMPLE 17

10 1. DMSO, Oxalyl Chloride

2. Carbomethoxytri-  
phenylphosphorane



(2-10)



25 (2-11)

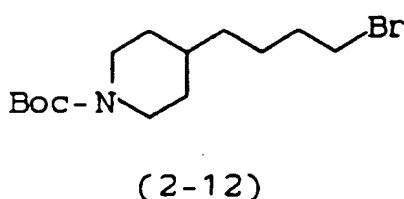
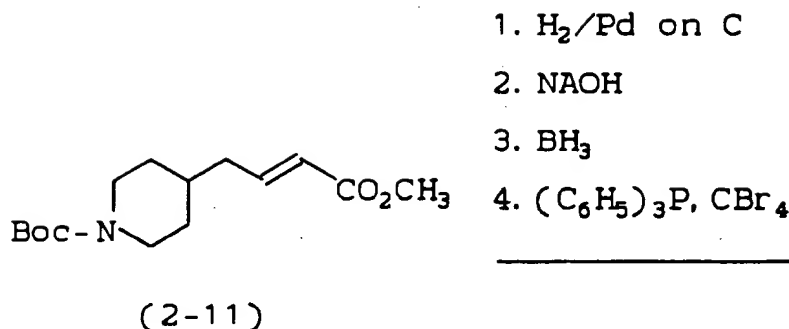
## 30 Methyl 4-(4-N-t-Butyloxycarbonylpiperidinyl)-but-2-enoate (2-11)

Oxalyl chloride (55.8 mL, 0.64 mole) was dissolved in 1 L  $\text{CH}_2\text{Cl}_2$  and cooled to  $-78^\circ\text{C}$  under  $\text{N}_2$ . DMSO (54.2 mL, 0.76 mole) was added dropwise. After gas evolution had ceased, 2-10 (102.5 g, 0.45 mole) dissolved in 200 mL  $\text{CH}_2\text{Cl}_2$  was added over 20 minutes. After stirring an additional 20 minutes, triethylamine (213 mL, 1.53 mole) was added dropwise and the cold bath removed. After 1 and 1/2 hours TLC showed starting material gone. Carbomethoxytri-  
35 phosphorane (179 g, 0.536 mole) was added and the reaction stirred overnight. The solution was diluted with 300 mL  $\text{Et}_2\text{O}$ , extracted once with 800 mL  $\text{H}_2\text{O}$ , twice with 300 mL 10%  $\text{KHSO}_4$  solution, then once with 300 mL brine. The organic layer was dried over  $\text{MgSO}_4$ , filtered and evaporated. Column chromatography ( $\text{SiO}_2$ , 5% EtOAc/Hexanes) yielded 78.4 g (62%) of pure 2-11.

300 MHz  $^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  6.9 (ddd  $J = 15.6, 7.6, 7.6$  Hz, 1H), 5.8 (d,  $J = 15.6$  Hz, 1H), 4.0 (bs, 2H), 3.7 (s, 3H), 2.6 (t,  $J = 12.6$  Hz, 2H), 2.1 (t,  $J = 7.4$  Hz, 2H), 1.7-1.4 (m, 3H), 1.4 (s, 9H), 1.1 (m, 2H).



## EXAMPLE 18

4-(4-N-t-Butyloxycarbonylpiperidiny)butyl bromide (2-12)

Compound 2-11 (36.2 g, 0.128 mole), was dissolved in 500 mL EtOAc. 10% Palladium on carbon (10 g) was added as a slurry in EtOAc and the reaction was placed under H<sub>2</sub> (in a balloon) overnight. The reaction was filtered through Solka-Floc, the cake washed with EtOAc and the ethyl acetate evaporated to give 34.7 g (90%) of 4-(4-N-t-butyloxycarbonylpiperidin-4-yl)butanoate. TLC R<sub>f</sub> = 0.69 in 30% EtOAc/Hexanes.

<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 4.0 (bs, 2H), 3.6 (s, 3H), 2.60 (t, J = 12.3 Hz, 2H), 2.20 (t, J = 7.4, 2H), 1.6 (m, 4H), 1.40 (s, 9H), 1.40 (m, 1H), 1.20 (m, 2H), 1.0 (m, 2H).

The butanoate ester (45.3 g, 0.159 mole) was dissolved in CH<sub>3</sub>OH and treated with 1 N NaOH (500 mL, 0.5 mole) overnight. The solvent was removed in vacuo, water was added and the solution washed with ether, then acidified with 10% H<sub>2</sub>SO<sub>4</sub> solution. The aqueous layer was washed with ether, the ether layers were combined, washed with brine, dried (MgSO<sub>4</sub>), and concentrated to give the corresponding acid as a clear oil (41.85 g, 97% yield).

<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 4.0 (bs, 2H), 2.6 (m, 2H), 2.25 (m, 2H), 1.6 (bs, 4H), 1.4 (s, 9H), 1.3-0.9 (9H).

This acid (20.4 g, 0.077 moles) was treated with borane (BH<sub>3</sub>/THF, 235 mL, 235 mmole) in THF at 0° for 1 hour. NaOH (1N, 250 mL) was added dropwise and the solution stirred overnight. The reaction was concentrated to remove THF and extracted with ether. The ether extracts were combined, dried over MgSO<sub>4</sub>, filtered and evaporated to give the corresponding alcohol as 19.7 g of a colorless oil.

R<sub>f</sub> = 0.7 in 2:1 ethyl acetate/hexanes.

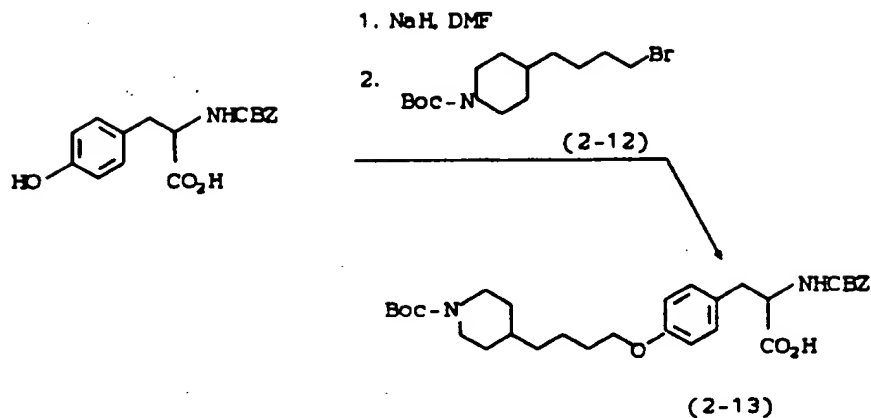
<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 4.1 (bs, 2H), 3.6 (t, 2H), 2.65 (t, 2H), 2.1 (bs, 1H), 1.65 (bs, 2H), 1.55 (m, 2H), 1.4 (s, 9H), 1.35 (m, 3H), 1.25 (m, 2H), 1.1 (m, 2H).

This alcohol (19.7 g, 76.5 mmole) was dissolved in THF and treated with triphenylphosphine (23.1 g, 88 mmol) and cooled to 0° C. Carbon tetrabromide (29.8 g, 89.9 mmol) was added in one portion, the cold bath was removed and the reaction stirred overnight. Additional triphenyl phosphine (11.71 g) and carbon tetrabromide (14.9 g) was added to drive the reaction to completion. The mixture was filtered and the liquid was diluted with ether and filtered again. After solvent removal the resulting liquid was adsorbed onto SiO<sub>2</sub> and chromatographed with 5% EtOAc/Hexanes to yield 2-12 as a clear colorless oil (20.7 g, 85% yield).

R<sub>f</sub> = 0.6 in 1:4 ethyl acetate/hexanes

<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 4.1 (bs, 2H), 3.4 (t, 2H), 2.65 (t, 2H), 1.85 (m, 2H), 1.65 (bd, 2H), 1.4 (s, 9H), 1.35 (m, 2H), 1.3 (m, 3H), 1.1 (m, 2H).

## EXAMPLE 19



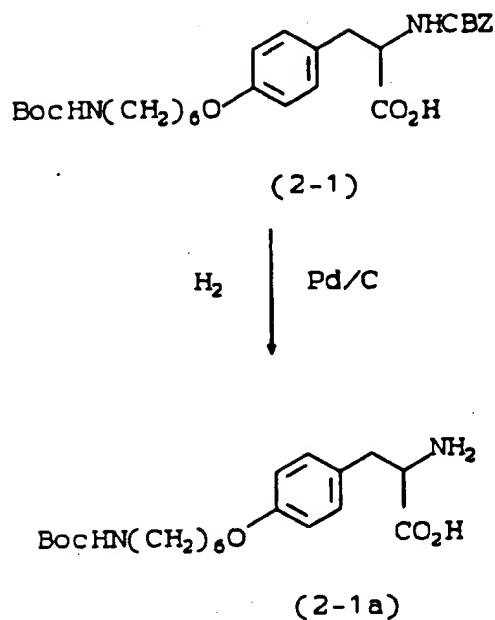
25

2-S-(N-(Benzyloxycarbonylamino)-3-[4-(4-N-t-butyloxycarbonylpiperidin-4-yl)butyloxy]phenyl]propionic acid (2-13)

N-CBZ-L-tyrosine was alkylated with 2-12 as taught for compound 2-5 in Example 12 to provide 2-13 in 87% yield.  
 $R_f = 0.15$  in 97:3:1  $\text{CHCl}_3/\text{CH}_3\text{OH}/\text{HOAc}$ , iodine stain.  
 $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  7.2 (d,  $J = 7.5$  Hz, 2H), 7.1 (d,  $J = 7.5$  Hz, 2H), 7.0 (d,  $J = 7.3$  Hz, 2H), 6.8 (d,  $J = 7.3$  Hz, 2H), 5.2 (d,  $J = 7.9$  Hz, 1H), 5.1 (s, 2H), 4.6 (m, 1H), 4.01 (bd, 2H), 3.92 (t,  $J = 6$  Hz, 2H), 6.7 (m, 2H), 2.65 (bt, 7H), 1.75-1.4 (m, 7H), 1.45 (s, 9H), 1.3 (m, 2H), 1.1 (m, 2H).



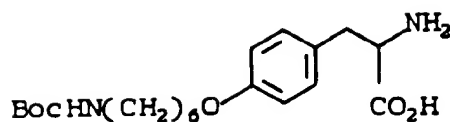
Mass Spec. (FAB)  $m/e = 455 (m + 1)$ .

EXAMPLE 212-S-Amino-3-[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propionic acid (2-1a)

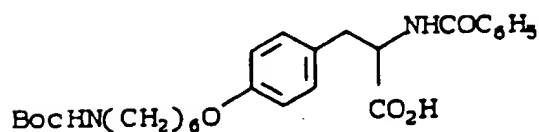
30 A solution of compound 2-1 (0.52 g, 1.0 mmole) in 20 mL of 4:1 ethanol/HOAc was hydrogenated under balloon pressure for 8 hours. The catalyst was filtered off and the solvent removed on the rotary evaporator to give a residue that was triturated with 30 mL ether to provide 0.16 g of 2-1a.

$^1\text{H}$  NMR (300MHz,  $\text{CD}_3\text{OD}$ )  $\delta$  1.40 (9H, m), 1.75 (2H, m), 2.90-3.05 (3H, m), 3.10-3.23 (3H, m), 3.70 (1H, m), 3.96 (3H, t), 6.88 (2H, d), 7.20 (2H, d).

## EXAMPLE 22



(2-1a)



(2-15)

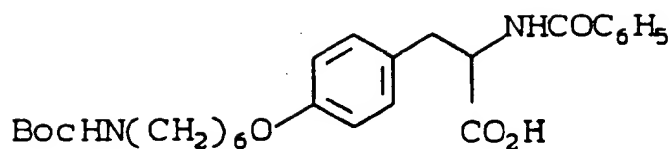
2-S-(Phenylcarbonylamino)-3[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl] propionic acid (2-15)

0.152 g (0.4 mmole) of compound 2-1a was added to a solution of 1 N NaOH (0.4 ml) in 10 mL H<sub>2</sub>O and this was stirred at 0-5 degrees C for 10 minutes as most of the solid dissolved. To this vigorously stirred suspension was added benzoyl chloride (0.062 g, 0.44 mmole) followed by solid sodium bicarbonate (0.037 g, 0.44 mmol) and the resulting mixture was stirred at 0-5° C for 1 hour.

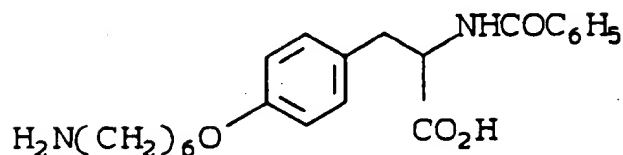
The reaction mixture was then diluted with 30 mL H<sub>2</sub>O and acidified to pH 2-3 with 10% KHSO<sub>4</sub> solution. This was extracted with 3 x 50 mL EtOAc and the combined organic extract was washed with 30 mL of H<sub>2</sub>O, 30 mL of brine and dried (Na<sub>2</sub>SO<sub>4</sub>). Solvent removal provided a viscous residue that was purified by flash chromatography on silica gel eluting with chloroform(95)-methanol(5) to give 2-15 as a viscous residue.

<sup>1</sup>H NMR (300MHz, CDCl<sub>3</sub>) δ 1.40 (9H, m), 1.75 (2H, bs), 3.20 (m, 4H), 3.92 (2H, m), 5.03 (2H, m), 6.79 (2H, d), 7.10 (2H, d), 7.45 (3H, m), 7.72 (2H, m).

## EXAMPLE 23



(2-15)

 $\xrightarrow[\text{EtOAc}]{\text{HCl}}$ 


(2-16)

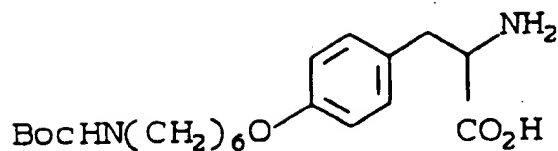
2-S-Phenylcarbonylamino-3-[4-(6-aminohexyloxy)phenyl]propionic acid hydrochloride (2-16)

0.28 g (2.0 mmole) of compound 2-15 was dissolved in 20 mL of EtOAc and this was cooled to  $-15^\circ\text{C}$  and HCl gas was bubbled into the solution for 10 minutes. The resulting mixture was stoppered and stirred at  $0^\circ\text{C}$  for 1.5 hours at which point all starting material was consumed. The solvent was then removed on the rotary evaporator to afford a white, foam-like residue. This was stirred with 30 mL ether for 1 hour and the resulting solid was collected by filtration to provide pure 2-16 as a white solid.

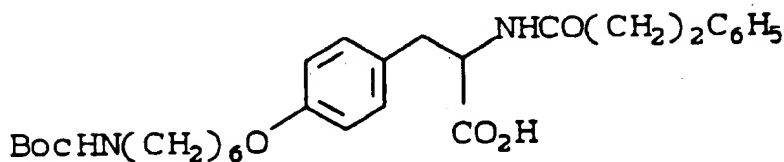
$^1\text{H}$  NMR (300MHz,  $\text{CD}_3\text{OD}$ ),  $\delta$  1.50 (3H, m), 1.70 (2H, m), 1.78 (2H, m), 2.90 (2H, t), 3.21 (4H, m), 3.94 (2H, t), 6.80 (2H, d), 7.19 (2H, d), 7.42 (2H, m), 7.50 (1H, m), 7.72 (2H, d).

Analysis for $\text{C}_{22}\text{H}_{38}\text{N}_2\text{O}_4\cdot\text{HCl}\cdot 0.75\text{H}_2\text{O}$			
Calc.:	C = 60.82,	H = 6.90,	N = 6.45.
Found:	C = 60.89,	H = 6.67,	N = 6.35.

## EXAMPLE 24



(2-1a)



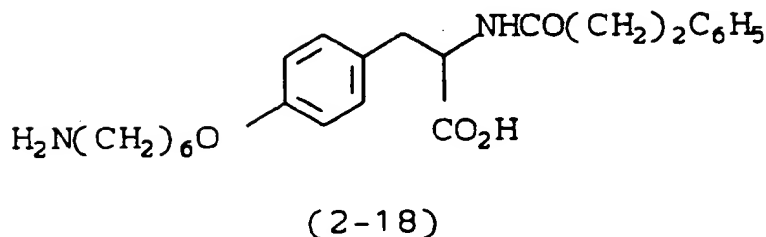
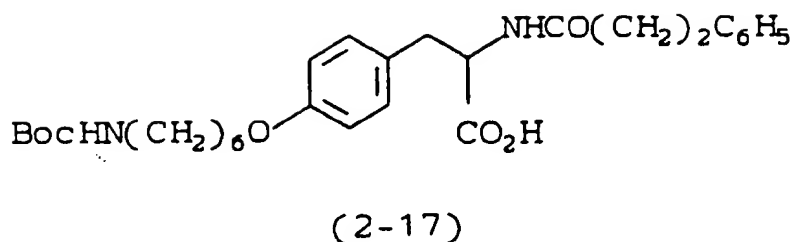
(2-17)

2-S-Phenethylcarbonylamino-3[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propanoic acid (2-17)

To a stirred solution of 1.2 mL 1 N NaOH in 15 mL H<sub>2</sub>O cooled to 0-5° C was added 0.457 g (1.2 mmole) of compound 2-1a and the resulting mixture was stirred for 10 minutes during which time most of the solid dissolved. To this vigorously stirred suspension was then added 3-phenylpropanoyl chloride (0.223 g, 1.32 mmole) followed by solid sodium carbonate (0.111 g, 1.32 mmole). The resulting white mixture was stirred vigorously at 0-5° C for 1.5 hours. The reaction mixture was then diluted with 40 mL H<sub>2</sub>O and this was acidified to pH 2-3 with a 10% KHSO<sub>4</sub> solution. The resulting aqueous phase was then extracted with 4 x 50 mL portions of EtOAc, and the combined organic phase was washed with 50 mL H<sub>2</sub>O, 50 mL brine and dried (Na<sub>2</sub>SO<sub>4</sub>). Solvent removal gave a viscous solid that was purified by flash chromatography on silica gel, eluting with chloroform (95)-methanol(5) to give 0.30 g of pure 2-17 as a clear viscous gum.

<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 1.40 (9H, m), 1.72 (2H, bs), 2.50 (2H, m), 3.02 (6H, m), 3.91 (2H, m), 6.72 (2H, d), 6.88 (2H, m), 7.20 (3H, m), 7.29 (2H, m).

## EXAMPLE 25

2-S-Phenethylcarbonylamino-3-[4-(6-aminohexyloxy)phenyl]propanoic acid hydrochloride (2-18)

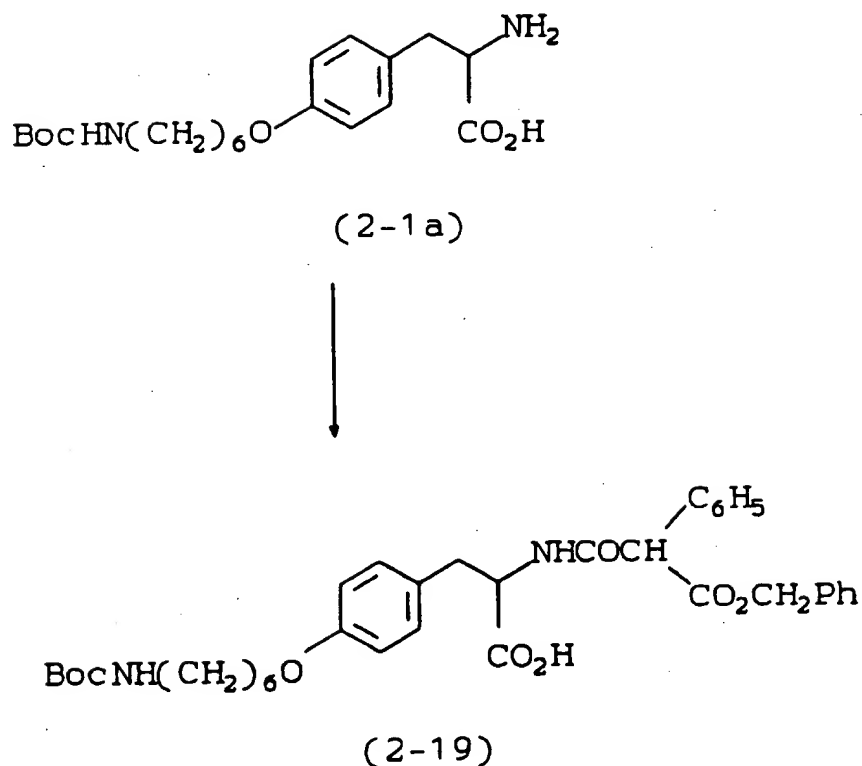
35 A solution of compound 2-17 (0.3 g, 3.0 mmole) in 15 mL EtOAc was cooled to -15° C and HCl gas was bubbled in for 10 minutes. The stoppered reaction mixture was then stirred for 2 hours at 0° C at which time all 2-17 was consumed. The solvent was then removed on the rotary evaporator and the resulting foam was triturated with 40 mL ether at room temperature for 1.0 hour to give pure 2-18 as a white solid, 0.22 g.

40 <sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.48 (3H, m), 1.67 (2H, m), 1.80 (2H, m), 2.46 (2H, m), 2.80 (3H, m), 2.90 (2H, m), 3.30 (3H, m), 3.95 (2H, t), 6.79 (2H, d), 7.06 (2H, d), 7.15 (3H, m), 7.22 (2H, m).

Analysis for C <sub>24</sub> H <sub>32</sub> N <sub>2</sub> O <sub>4</sub> ·HCl·H <sub>2</sub> O			
Calc.:	C = 61.72,	H = 7.55,	N = 6.00.
Found:	C = 61.97,	H = 7.11,	N = 5.96.



## EXAMPLE 26



2-S-(2-N-(2-Benzyloxycarbonyl)phenylacetyl)amino-3[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propionic acid  
(2-19)

35 To a cold solution of 1.8 mL of 1 N NaOH in 15 mL H<sub>2</sub>O was added 0.685 g (1.8 mmole) of compound 2-1a with stirring to give, after 10 minutes, a clear solution. Then, 2-benzyloxycarbonylphenylacetyl chloride (0.577 g, 2.0 mmole) was added followed by sodium bicarbonate (0.168 g, 2.0 mmole) and the resulting mixture was stirred at 0-5° C for 1.0 hour. The reaction mixture was diluted with water, acidified to pH 2-3 with 10% KHSO<sub>4</sub> solution and extracted with 4 x

40 500 mL portions of EtOAc. The combined organic extracts were washed with brine, dried (Na<sub>2</sub>SO<sub>4</sub>) and the solvent was removed to give a viscous amber residue. This was purified by column chromatography on silica gel, eluting with CHCl<sub>3</sub> (98)-methanol (2) to give 0.326 g of pure 2-19 as an oil.

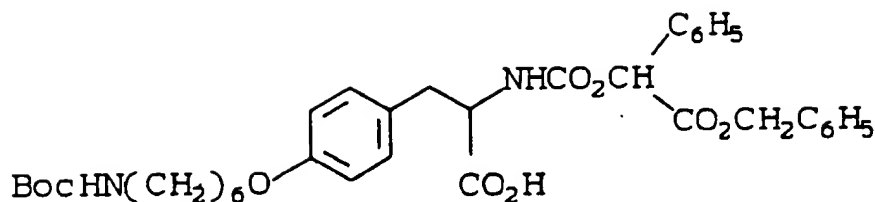
<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>) δ 1.45 (9H, 6s), 1.75 (2H, 6s), 3.07 (4H, m), 3.89 (2H, bs), 4.57 (2H, bs), 5.15 (2H, m), 6.69 (2H, d), 6.88 (2H, d), 7.30 (5H, m).

45

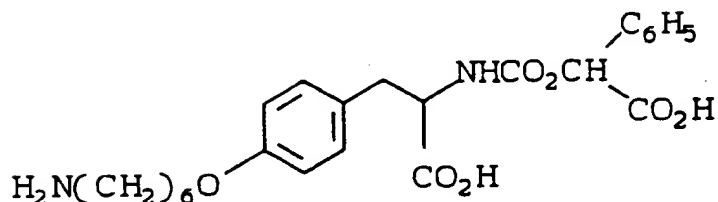
50

55

## EXAMPLE 27



(2-19)



(2-20)

2-S-(2-Carboxyphenylacetyl-amino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid hydrochloride (2-20)

Compound 2-19 (0.34 g, 0.55 mmole) was dissolved in 25 mL absolute ethanol and after adding 100 mg 10% Pd/C the suspension was hydrogenated under balloon pressure. Then, the catalyst was filtered off and the solvent removed on the rotary evaporator to give 0.25 g of 2-S-(2-Carboxyphenylacetyl-amino)-3-[4-(6-t-butyloxycarbonylamino-hexyloxy)phenyl]propionic acid.

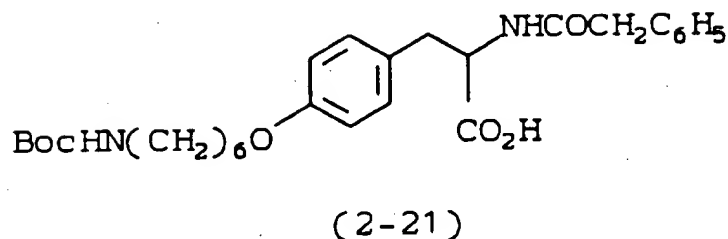
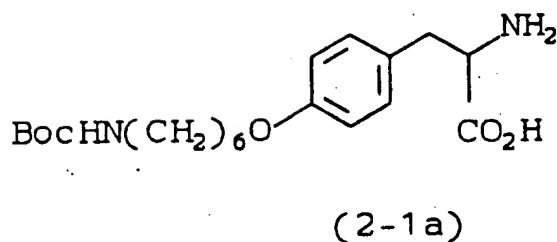
$^1\text{H}$  NMR (300MHz,  $\text{CD}_3\text{OD}$ )  $\delta$  1.47 (12H, m), 1.78 (2H, m), 3.06 (3H, m), 3.32 (4H, m), 3.92 (2H, m), 4.60 (2H, m), 6.72 (2H, d), 6.96, (2H, d), 7.30 (5H, m).

This acid was dissolved in 25 mL EtOAc and treated with HCl gas as described for compound 2-2 in Example 9. Solvent removal provided a residue that was purified by flash chromatography on silica gel eluting with 9:1:1 ethanol/ $\text{H}_2\text{O}$ / $\text{NH}_4\text{OH}$  to give pure 2-20.

$^1\text{H}$  NMR (300 MHz,  $\text{D}_2\text{O}$ )  $\delta$  1.55 (H, m), 1.90 (2H, m), 2.83-3.09 (4H, m), 3.28 (1H, m), 4.15 (2H, m), 6.88-7.45 (9H, m).

Analysis for $\text{C}_{24}\text{H}_{30}\text{N}_2\text{O}_6 \cdot 1.5 \text{H}_2\text{O} \cdot 0.25 \text{NH}_3$			
Calc.:	C = 60.84,	H = 7.18,	N = 6.65.
Found:	C = 60.48,	H = 6.81,	N = 6.99.

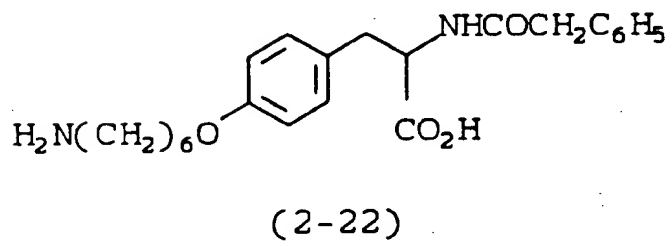
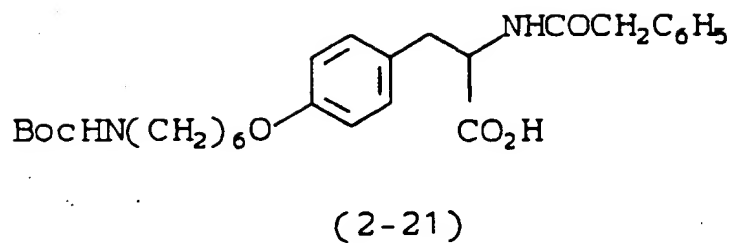
## EXAMPLE 28

2-S-(Phenylacetyl-amino)-3-[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propionic acid (2-21)

Compound 2-1a (0.685 g, 1.8 mmole) was acylated with phenylacetyl chloride as described for compound 2-19 in Example 26. The crude product was purified by flash chromatography on silica gel eluting with 95:5:0.5 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc to give pure 2-21 as a viscous oil. (0.35 g).

<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.45 (12H, m), 1.78 (2H, m), 2.88 (1H, m), 3.10 (3H, m), 3.30 (1H, m), 3.48 (2H, m), 3.92 (2H, m), 4.61 (1H, m), 6.74 (2H, d), 7.02 (2H, d), 7.12 (2H, m), 7.22 (3H, m).

## EXAMPLE 29

2-S-(Phenylacetyl-amino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid (2-22)

35 Compound 2-21 (0.35 g) was dissolved in 25 mL EtOAc and this solution was treated with HCl gas as described for compound 2-16 in Example 23 to give 0.26 g pure 2-22 as a white solid.

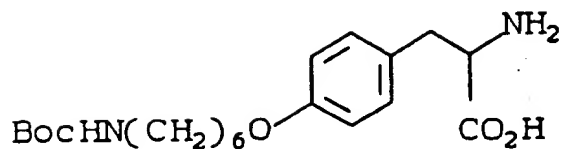
<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.50 (6H, m), 1.65 (2H, m), 2.20 (2H, m), 2.88 (3H, m), 3.12 (1H, m), 3.30 (2H, m), 3.47 (2H, m), 3.94 (2H, m), 4.61 (1H, m), 6.75 (2H, d), 7.02 (2H, d), 7.13 (2H, d), 7.30 (3H, m).

40

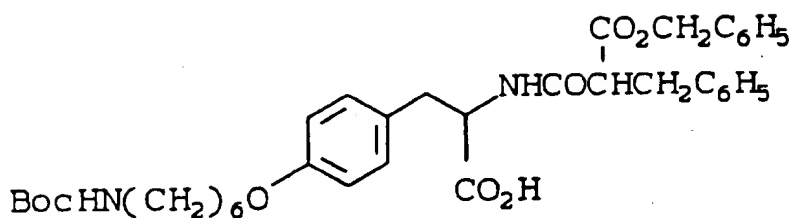
Analysis for C <sub>23</sub> H <sub>30</sub> N <sub>2</sub> O <sub>4</sub> ·HCl·H <sub>2</sub> O			
Calc.:	C = 60.98,	H = 7.34,	N = 6.19.
Found:	C = 61.29,	H = 6.92,	N = 6.12.

45

## EXAMPLE 30



(2-1a)



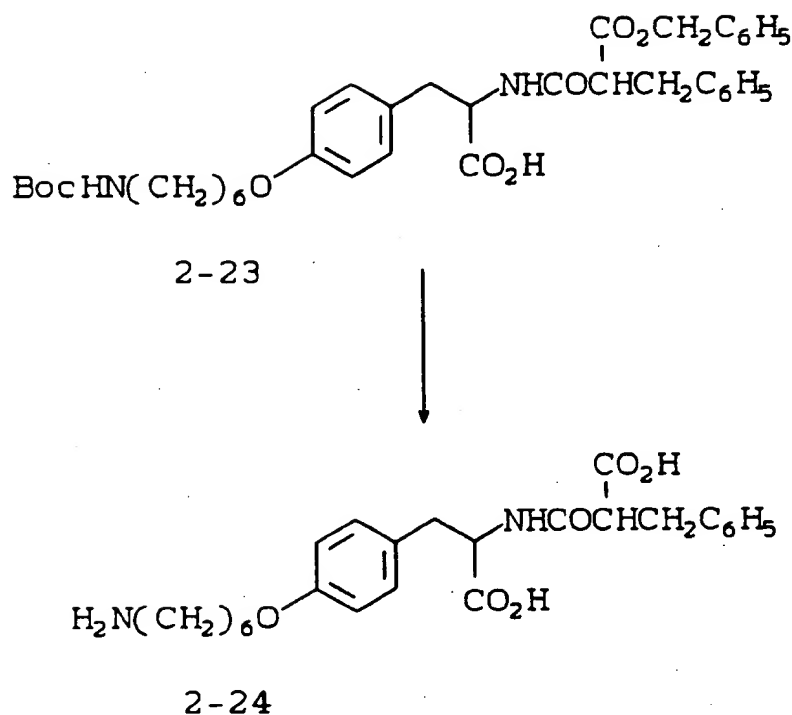
(2-23)

2-S-[(2-N-Benzyloxycarbonyl-3-phenylpropionylamino)-3-[4-(6-N-t-butyloxycarbonylamino-hexyloxy)phenyl]propionyl]-cacid (2-23)

Compound 2-1a (0.685 g, 1.8 mmole) was acylated with 2-N-benzyloxycarbonyl-3-phenylpropionylchloride as described for compound 2-19 in Example 26. The crude product was purified by flash chromatography on silica gel eluting with 98:2:1 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc to give pure 2-23 as a viscous oil.

<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.40 (16 H, m), 1.61 (2H, m), 3.03 (8H, m), 3.30 (6H, m), 3.71 (1H, m), 3.86 (2H, m), 4.60 (1H, m), 5.02 (2H, m), 6.70 (2H, d), 6.86, (1H, d), 7.02 (1H, s), 7.22 (5H, m).

## EXAMPLE 31



## 2-S-(2-Carboxy-3-phenylpropionylamino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid (2-24)

Compound 2-23 (0.49 g, 0.76 mmole) was dissolved in 25 mL ethanol and after the addition of 100 mg 10% Pd/C was hydrogenated at balloon pressure overnight. Solvent removal provided 2-S-(2-carboxy-3-phenylpropionylamino)-3-[4-(6-N-t-butyloxycarbonylamino-hexyloxy)phenyl]propionic acid as a viscous residue (0.35 g).

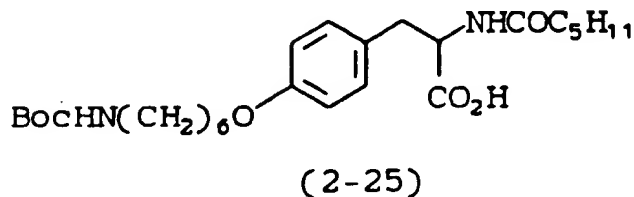
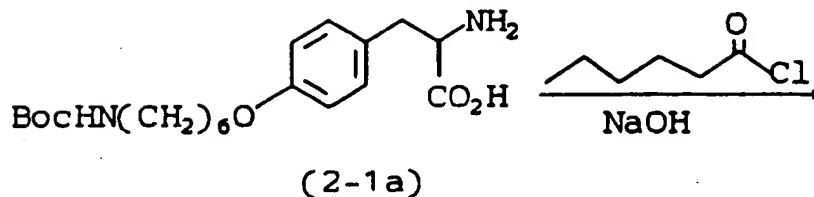
<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.42 (10H, m), 1.75 (2H, m), 2.80-3.15 (5H, m), 3.30 (1H, m), 3.90 (2H, m), 4.58 (2H, m), 6.68-6.85 (4H, m), 7.06-7.27 (5H, m).

This acid (0.32 g) was treated with HCl gas as described for compound 2-12 to give after solvent removal a crude product that was purified by flash chromatography on silica gel eluting with 90:5:5 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc to provide the diastereomeric products 2-24a and 2-24b.

2-24a had <sup>1</sup>H NMR (300 MHz, D<sub>2</sub>O) δ 1.58 (4H, m), 1.83 (4H, m), 2.95 (2H, m), 3.08 (3H, m), 3.20 (1H, m), 3.51 (1H, m), 4.18 (2H, m), 4.53 (1H, m), 4.95 (2H, g), 6.92 (4H, m), 7.43 (5H, m).

2-24b had <sup>1</sup>H NMR (400 MHz, D<sub>2</sub>O) δ 1.40 (4H, m), 1.62 (2H, m), 1.73 (2H, m), 2.90 (6H, m), 3.31 (1H, m), 4.17 (2H, m), 4.32 (1H, m), 6.93 (2H, d), 7.07 (2H, d), 7.15 (2H, d), 7.26 (3H, m).

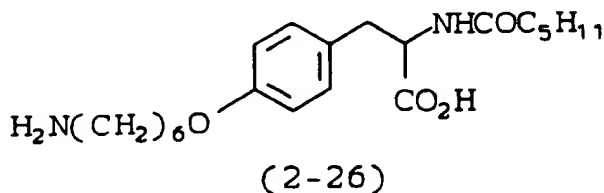
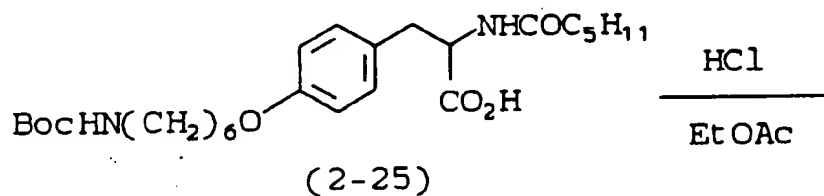
## EXAMPLE 31(a)

2-S-(Hexanoylamino)-3-[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propionic acid (2-25)

25 2-1a (0.685 g, 1.8 mmole) was treated with hexanoyl chloride (0.38 g, 2.0 mmole) as described for 2-15 to provide crude 2-25. This was purified by flash chromatography on silica gel eluting with 95:5:1 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc to give pure 2-25 as an oil (0.35 g, 41%).

30 <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 0.89 (3H, t), 1.20-1.65 (21H, m), 1.75 (2H, m), 2.19 (2H, t), 3.11 (4H, m), 3.92 (2H, m), 4.83 (1H, m), 6.80 (2H, d), 7.05 (2H, d).

## EXAMPLE 31(b)

2-S-(Hexanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid hydrochloride (2-26)

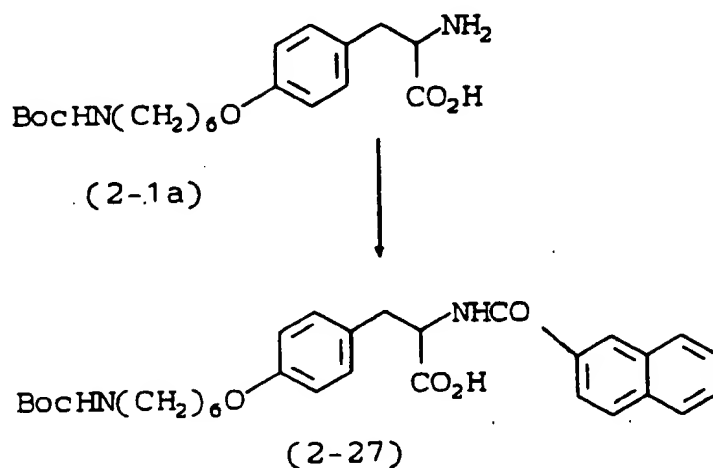
55 2-25 (0.35 g, 0.75 mmole) was dissolved in 30 mL EtOAc and treated with HCl as described for compound 2-2 to give a foam-like solid that was triturated with 50 mL of ether for 1 hour at room temperature. This gave pure 2-26 as a

white solid. (0.186 g).

$^1\text{H}$  NMR (300 MHz,  $\text{CD}_3\text{OD}$ )  $\delta$  0.85 (3H, t), 1.20 (4H, m), 1.48 (6H, m), 1.68 (2H, m), 1.77 (2H, m), 2.14 (2H, m), 4.61 (1H, m), 6.80 (2H, d), 7.13 (2H, m).

Analysis for $\text{C}_{21}\text{H}_{34}\text{N}_2\text{O}_4 \cdot \text{HCl} \cdot 0.5 \text{H}_2\text{O}$			
Calc:	C=59.49,	H=8.56,	N=6.61
Found:	C=59.32,	H=8.48,	N=6.55

### EXAMPLE 31(c)



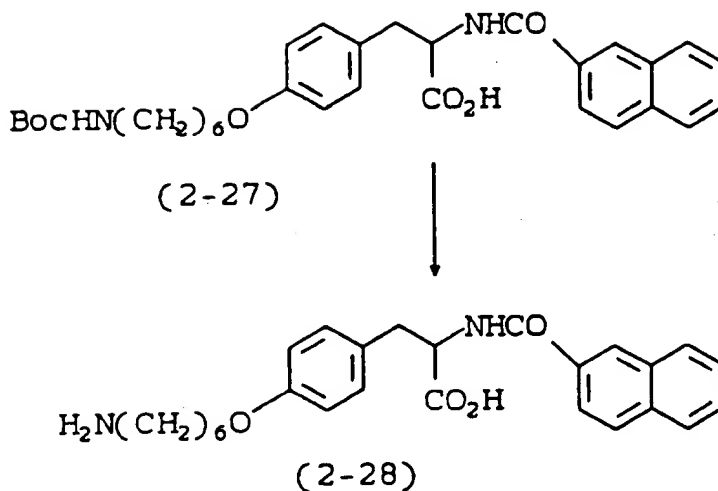
### 2-S-(2-Napthanoylamino)-3-[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propionic acid (2-27)

2-1a (0.685 g, 1.8 mmole) was treated with 2-napthanoyl chloride (0.409 g, 2.0 mmole) as described for 2-15 to provide crude 2-27. This was purified by flash chromatography on silica gel eluting with 95:4:1  $\text{CHCl}_3/\text{CH}_3\text{OH}/\text{HOAc}$  to give pure 2-27 as a white solid (0.14 g).

$^1\text{H}$  NMR (300 MHz,  $\text{CD}_3\text{OD}$ )  $\delta$  1.45 (16H, m), 1.70 (2H, m), 2.88 (1H, m), 3.08 (3H, m), 3.57-3.80 (4H, m), 4.62 (1H, m), 6.54 (2H, d), 6.92 (2H, d), 7.25 (1H, d), 7.42 (2H, m), 7.61 (1H, bs), 7.77 (3H, m).



## EXAMPLE 31(d)

25 2-S-(Naphthanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid (2-28)

2-27 (0.14 g, 0.31 mmole) was dissolved in 25 mL EtOAc and treated with HCl gas as described for 2-2. Crude product was purified by flash chromatography on silica gel eluting with 10:1:1 C<sub>2</sub>H<sub>5</sub>OH/H<sub>2</sub>O/NH<sub>4</sub>OH to give pure 2-28 (55 mg) as a white solid.

30 <sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD), δ 1.42 (5H, m), 1.71 (2H, m), 2.63 (2H, m), 2.86 (1H, m), 3.07 (2H, m), 3.30 (3H, m), 3.55-3.75 (4H, m), 4.47 (1H, m), 6.43 (2H, d), 6.82 (2H, d), 7.30 (1H, dd), 7.45 (2H, m), 7.64 (1H, bs), 7.80 (3H, m).

35

Analysis for C <sub>27</sub> H <sub>32</sub> N <sub>2</sub> O <sub>4</sub> ·0.5 H <sub>2</sub> O			
Calc.:	C=70.87,	H=7.27,	N=6.12
Found:	C=70.93,	H=7.04,	N=6.11

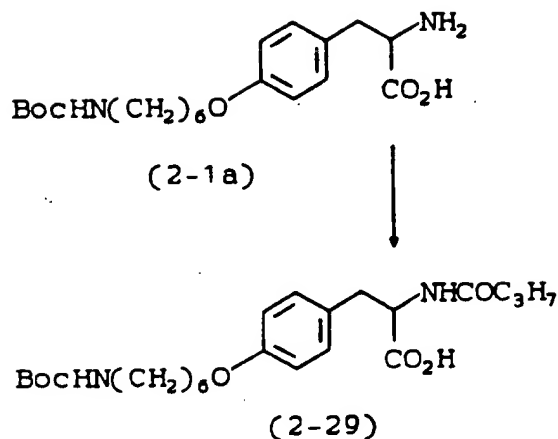
40

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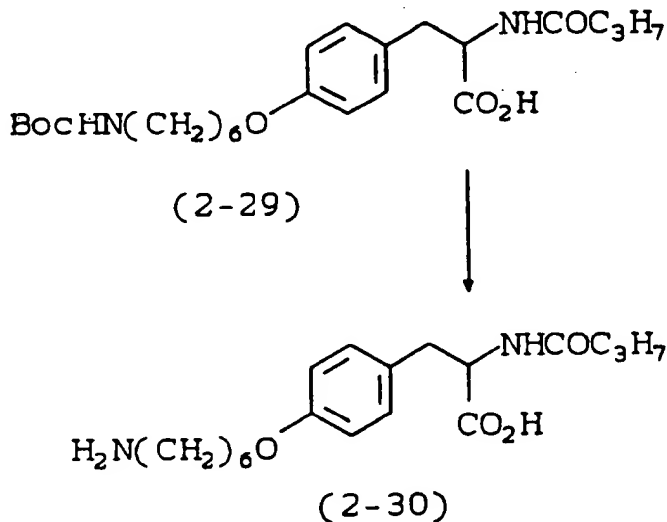
55

## EXAMPLE 31(e)

2-S-(2-Butanoylamino)-3-[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propionic acid (2-29)

2-1a (0.685 g, 1.8 mmole) was acylated with butanoyl chloride as described for 2-15 to give crude 2-29. This was purified by flash chromatography eluting with 95:4:1 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc to provide pure 2-29 as an oil.  
<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 0.73 (3H, t), 1.32-1.60 (16H, m), 1.73 (2H, m), 2.12 (2H, m), 2.87 (1H, m), 3.03 (2H, t), 3.12 (1H, m), 3.92 (2H, t), 4.61 (1H, m), 6.80 (2H, d), 7.12 (2H, d).

## EXAMPLE 31(f)

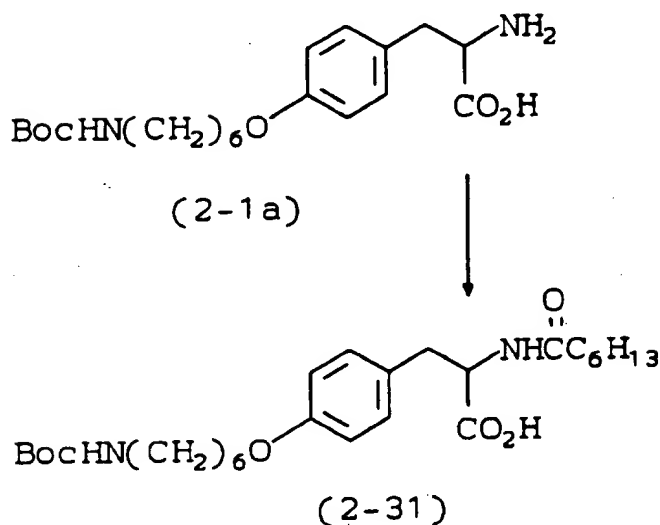
2-S-(Butanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid (2-30)

2-29 (0.05 g, 1.0 mmole) was dissolved in 25 mL ethyl acetate and treated with HCl gas as described for 2-2. Crude reaction product was triturated with 25 mL ether to give pure 2-30 as a white solid.  
<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 0.72 (3H, t), 1.45-1.60 (6H, m), 1.70 (2H, m), 1.79 (2H, m), 2.12 (2H, m), 2.80-2.95 (3H,

m), 3.14 (1H, dd), 3.30 (1H, m), 3.95 (2H, t), 4.40 (1H, m), 6.80 (2H, d), 7.13 (2H, d).

Analysis for $C_{19}H_{30}N_2O_4 \cdot HCl \cdot H_2O$			
Calc.:	C = 56.35,	H = 8.21,	N = 6.92
Found:	C = 56.70,	H = 8.12,	N = 6.91.

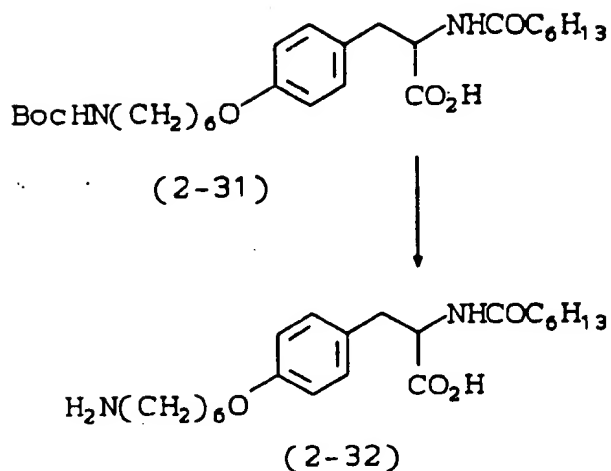
# EXAMPLE 31(g)



## 2-S-(Heptanoylamino)-3-[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propionic acid (2-31)

2-1a (0.685 g, 1.8 mmole) was acylated with heptanoyl chloride as described for 2-15. Crude product was purified by flash chromatography on silica gel eluting with 96:3:1  $CHCl_3/CH_3OH/HOAc$  to give pure 2-31 (0.07 g) as an oil.  $^1H$  NMR (300 MHz,  $CD_3OD$ )  $\delta$  0.78 (3H, t), 1.22 (6H, m), 1.32-1.55 (16H, m), 1.73 (2H, m), 2.13 (2H, m), 2.85 (1H, m), 3.02 (2H, t), 3.15 (1H, m), 4.91 (2H, t), 4.61 (1H, m), 6.81 (2H, d), 7.12 (2H, d).

## EXAMPLE 31(h)

2-S-(Heptanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid hydrochloride (2-32)

25 2-31 (0.070 g) was dissolved in 30 mL EtOAc and treated with HCl gas as described for 2-2. Crude reaction product was triturated with 30 mL ether to provide pure 2-32 (52 mg) as a white solid.

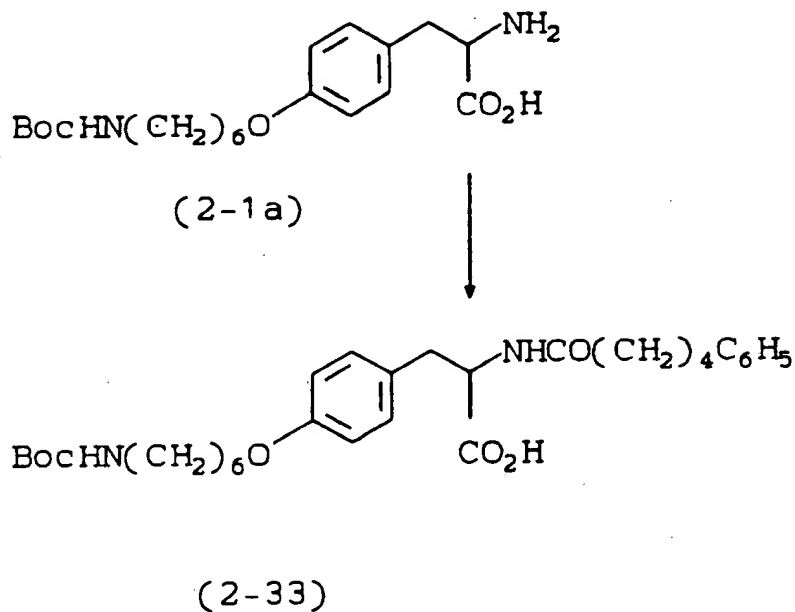
<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 0.88 (3H, t), 1.22 (6H, m), 1.47 (6H, m), 1.68 (2H, m), 1.78 (2H, m), 2.13 (2H, t), 2.80-2.95 (3H, m), 3.14 (1H, m), 3.30 (1H, m), 3.94 (2H, m), 4.61 (1H, m), 6.80 (2H, d), 7.13 (2H, d).

30

Analysis for C <sub>22</sub> H <sub>36</sub> N <sub>2</sub> O <sub>4</sub> ·HCl·0.75 H <sub>2</sub> O			
Calc.:	C = 59.71,	H = 8.77,	N = 6.33
Found:	C = 59.76,	H = 8.40,	N = 6.25.

35

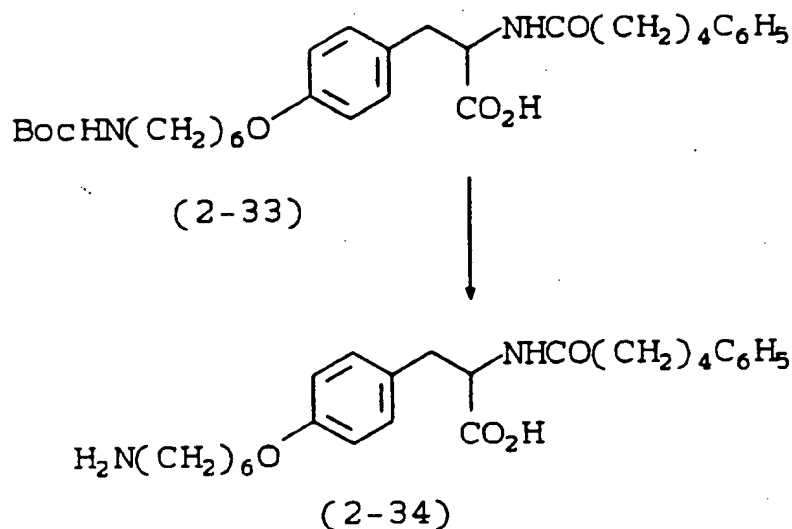
## EXAMPLE 31(i)

2-(S)-(5-Phenylpentanoylamino)-3-[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propionic acid (2-33)

30 2-1a (0.685 g, 1.8 mmole) was acylated with 5-phenylpentanoyl chloride as described for 2-15. Crude product was purified by flash chromatography on silica gel eluting with 96:3:1 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc to give pure 2-33 (0.49 g) as a clear oil.

35 <sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.32-1.60 (1H, m), 1.73 (2H, m), 2.18 (2H, m), 2.53 (2H, m), 2.80-2.90 (1H, m), 3.02 (2H, t), 3.04 (1H, m), 4.62 (1H, m), 6.78 (2H, d), 7.08-7.28 (7H, m).

## EXAMPLE 31(j)

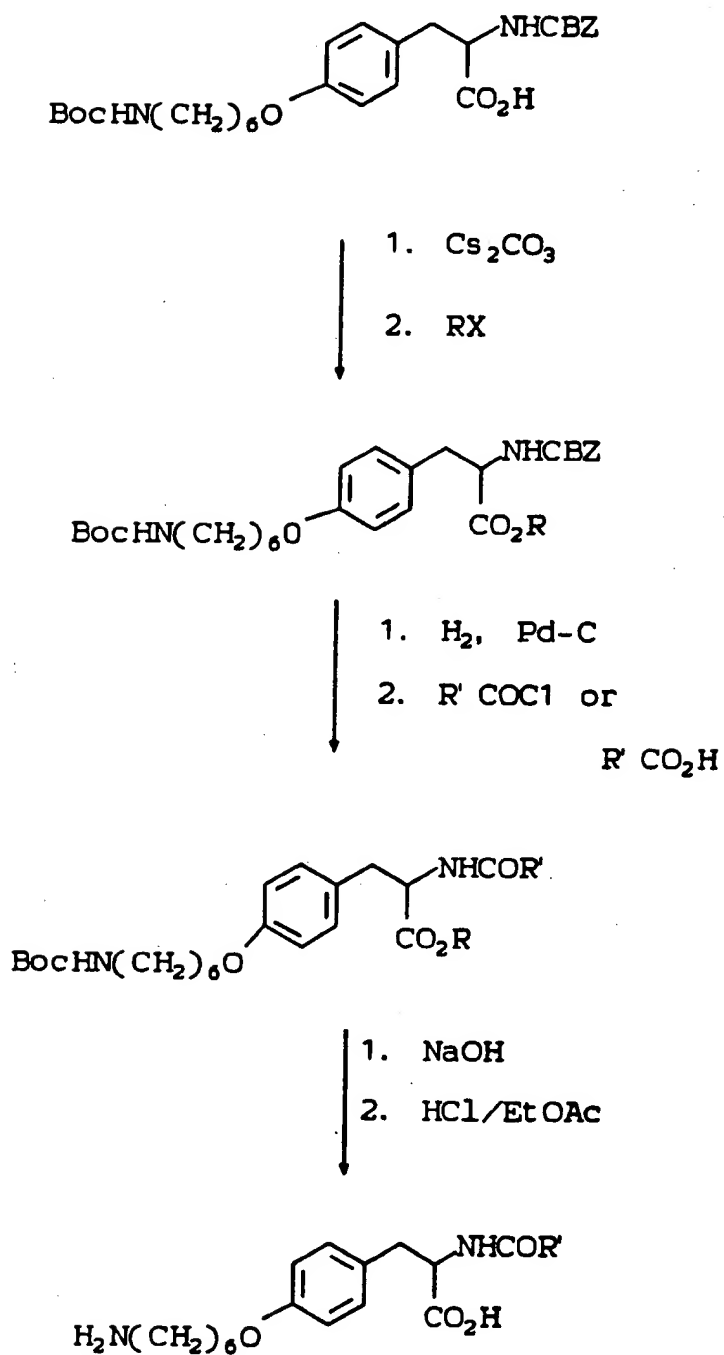
2-S-(5-Phenylpentanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid hydrochloride (2-34)

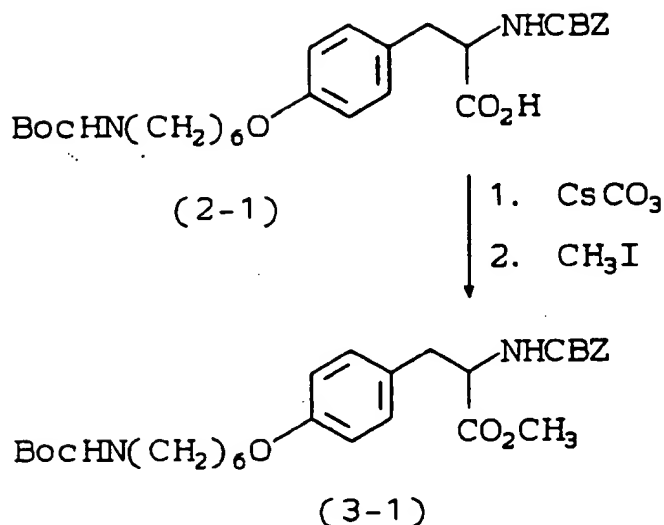
2-33 (0.49 g) was dissolved in 30 mL ethyl acetate and treated with HCl gas as described for 2-2. Crude product was triturated with 50 mL ether to give pure 2-34 (0.32 g) as a white solid.

$^1\text{H}$  NMR (300 MHz,  $\text{CD}_3\text{OD}$ )  $\delta$  1.40-1.58 (8H, m), 1.62-1.70 (2H, m), 1.80 (2H, m), 2.19 (2H, m), 2.55 (2H, m), 2.80-2.95 (3H, m), 3.15 (1H, m), 3.30 (1H, m), 3.90 (2H, t), 4.62 (1H, m), 6.88 (2H, d), 7.08-7.27 (7H, m).

Analysis for $\text{C}_{26}\text{H}_{36}\text{N}_2\text{O}_4 \cdot \text{HCl} \cdot \text{H}_2\text{O}$			
Calc.:	C = 64.24,	H = 7.88,	N = 5.76
Found:	C = 64.53,	H = 7.84,	N = 5.71.

## SCHEME 3



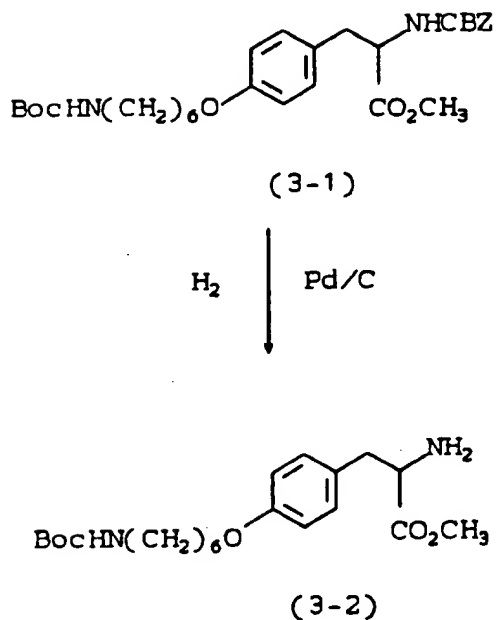
EXAMPLE 32

25 Methyl 2-S-(N-Benzyloxycarbonylamino)-3-[4-(6-N-t-butyloxycarbonylaminohexyl)oxyphenyl]propionate (3-1)

30 Compound 2-1 (10.0 g, 19.43 mmole) in 75 mL DMF was treated with cesium carbonate (3.16 g, 9.72 mmole) with stirring at room temperature for 2.0 hours. Then, methyl iodide (2.76 g, 19.43 mmole) was added dropwise and the reaction mixture was stirred overnight at ambient temperature. The solvent was removed at high vacuum (30 degrees C) and the residue was taken up in 300 mL EtOAc and washed with 2x40 mL portions of saturated NaHCO<sub>3</sub> solution, brine, and dried (Na<sub>2</sub>SO<sub>4</sub>). Solvent removal provided 3-1 (8.5 g, 83%) as a clear oil.

<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 1.25-1.53 (16H, m), 1.76 (2H, m), 2.96-3.17 (4H, m), 3.71 (3H, s), 3.90 (2H, t), 4.61 (1H, m), 5.10 (2H, m), 5.19 (1H, m), 6.88 (2H, d), 6.98 (sH, d), 7.32 (5H, m).

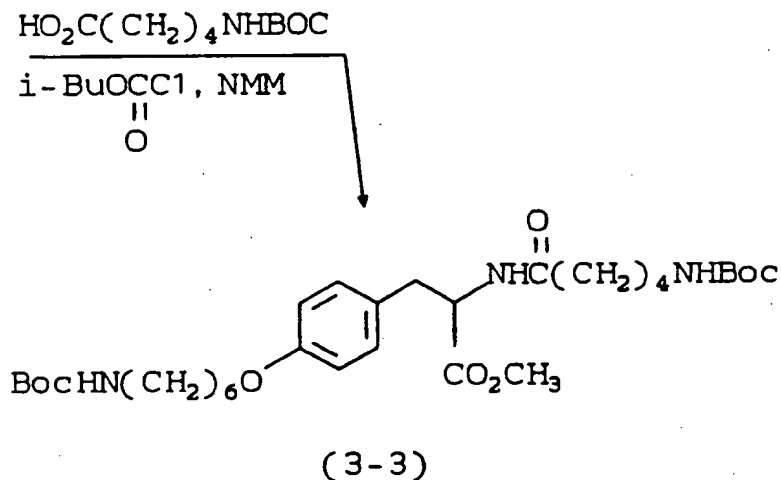
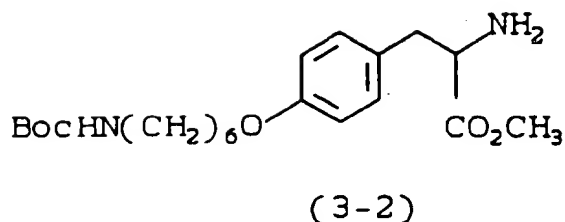


**EXAMPLE 33****Methyl 2-S-Amino-3-[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propionate (3-2)**

30      Compound 3-1 (8.0 g, 15.1 mmole) was dissolved in 150 mL absolute ethanol and 1.0 g 10% Pd/C was added. This suspension was hydrogenated in a Parr apparatus (50 psi) for 3.5 hours. The catalyst was then filtered off and the solvent removed on the rotary evaporator to give pure 3-2 (5.56 g) as a clear oil.  $R_f = 0.4$  on  $\text{SiO}_2$  with 95:5  $\text{CHCl}_3/\text{CH}_3\text{OH}$

35       $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  1.30-1.55 (16 H, m), 1.70 (2H, m), 2.80 (1H, m), 3.00-3.17 (3H, m), 3.71 (3H, s), 3.93 (2H, t), 6.82 (2H, d), 7.09 (2H, d).

## EXAMPLE 34



35

Methyl 2-S-[(5-N-t-Butyloxycarbonylamino)pentanoylamino]-3-[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propionate (3-3)

40

To a solution of 5-(N-t-butyloxycarbonylamino)pentanoic acid (0.293 g, 1.35 mmole) and N-methyl-morpholine (0.187 g, 1.35 mmole) in 10 mL EtOAc at 0-5° C was added i-butylochloformate (0.184 g, 1.35 mmole) via syringe and the resulting white suspension was stirred for 0.5 hours. Then, 3-2 (0.5 g, 1.27 mmole) dissolved in 10 mL EtOAc was added dropwise and the reaction mixture was stirred at 0° C for 2.0 hours. The reaction mixture was then diluted with 25 mL water/ 40 mL EtOAc and the organic phase was separated, washed with water, 10% KHSO<sub>4</sub>, water, saturated NaHCO<sub>3</sub>, brine and dried (Na<sub>2</sub>SO<sub>4</sub>). Solvent removal gave an oil that was purified by flash chromatography on silica gel eluting with 2% CH<sub>3</sub>OH/CHCl<sub>3</sub> (R<sub>f</sub> = 0.35) to give pure 3-3 (0.68 g, 90%) as a clear oil.

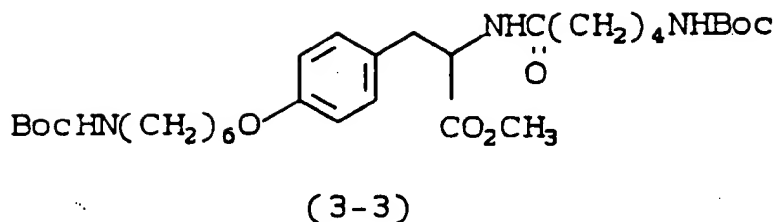
45

<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 1.35-1.55 (26H, m), 1.62 (2H, m), 1.68 (2H, m), 2.20 (2H, t), 3.0-3.16 (6H, m), 3.33 (3H, s), 3.92 (2H, t), 4.83 (1H, m), 6.80 (2H, d), 6.99 (2H, m).

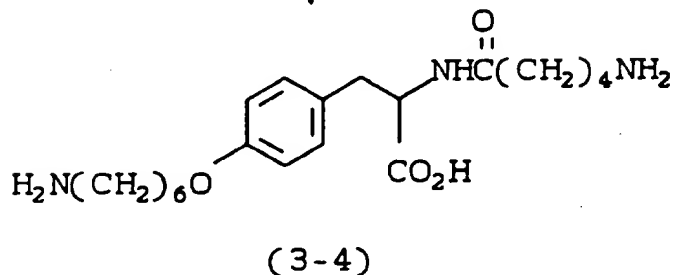
50

55

## EXAMPLE 35



- 15
1. LiOH
2. HCl, EtOAc

2-S-(5-Aminopentanoyl)amino-3-[4-(6-aminohexyloxy)phenyl]propionic acid dihydrochloride (3-4)

35 3-3 (0.68 g, 1.14 mmole) was dissolved in 30 mL THF(1)/H<sub>2</sub>O(1)/CH<sub>3</sub>OH(1), LiOH (0.137 g, 5.73 mmole) was added and the reaction mixture stirred at room temperature overnight. The solvent was then removed and the residue was taken up in 75 mL H<sub>2</sub>O and acidified to pH 2-3 with 10% KHSO<sub>4</sub> solution. This was extracted with EtOAc and the combined organic extracts were washed with brine and dried (Na<sub>2</sub>SO<sub>4</sub>). Solvent removal gave 2-S-(5-*t*-butyloxycarbonylaminopentyl)amino-3-[4-(6-*t*-butyloxycarbonylamino-hexyl)oxyphenyl]-propionic acid (0.65 g).

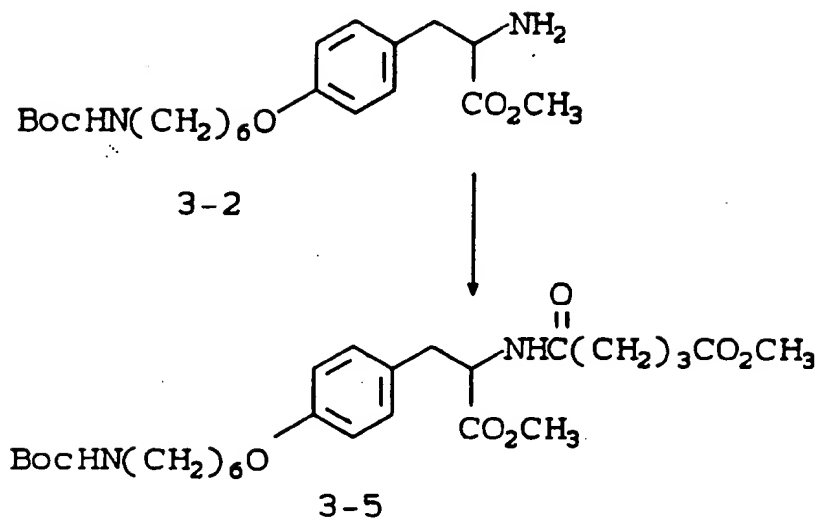
40 <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 1.40-1.55 (22H, m), 1.60 (2H, m), 1.73 (2H, m), 2.20 (2H, m), 3.10 (4H, m), 3.90 (2H, m), 4.60 (1H, m), 4.72 (1H, m), 4.83 (1H, m), 6.78 (2H, d), 7.05 (2H, d).

This acid was dissolved in EtOAc and was treated with HCl gas as described for 2-2. The crude hygroscopic white solid was triturated with a solution of 10 mL EtOAc/50 mL Et<sub>2</sub>O to give pure 3-4 as a white solid.

45 <sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.42-1.85 (14H, m), 2.23 (2H, m), 2.90 (6H, m), 3.14 (1H, dd), 3.30 (1H, m), 3.97 (2H, t), 4.60 (1H, m), 6.82 (2H, d), 7.13 (2H, d).

Analysis for C <sub>20</sub> H <sub>33</sub> N <sub>3</sub> O <sub>4</sub> ·2HCl·3H <sub>2</sub> O			
Calc.:	C = 47.43,	H = 8.16,	N = 8.30
Found:	C = 47.87,	H = 7.49,	N = 7.90

## EXAMPLE 36

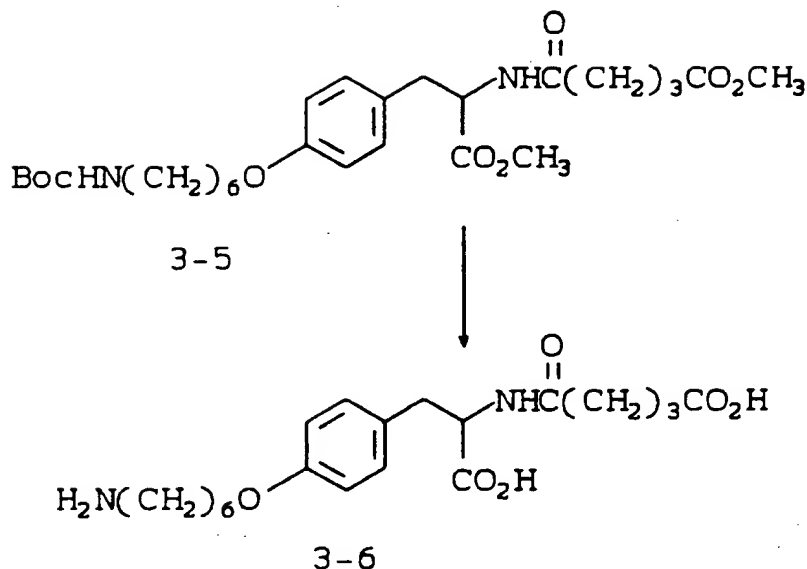


Methyl 2-S-(4-Carbomethoxybutanoyl)amino-3-[4-(N-t-butyloxycarbonylaminohexyloxy)phenyl]propionate (3-5)

To a solution of 3-2 (0.5 g, 1.27 mmole), 4-carbomethoxybutanoic acid (0.213 g, 1.5 mmole) and 1 drop of triethylamine in 20 mL CH<sub>3</sub>CN was added BOP reagent (0.66 g, 1.5 mmole) and the resulting clear solution was stirred overnight at room temperature. The solvent was removed on the rotary evaporator and the residue was taken up in EtOAc and this was washed with H<sub>2</sub>O, 10% KHSO<sub>4</sub>, H<sub>2</sub>O, saturated NaHCO<sub>3</sub>, brine and dried (Na<sub>2</sub>SO<sub>4</sub>). Solvent removal provided a residue that was purified by flash chromatography on silica gel eluting with 1% CH<sub>3</sub>OH/CHCl<sub>3</sub> to give pure 3-5 (110 mg) as a clear oil.

<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>), δ 1.35-1.55 (14H, m), 1.75 (3H, m), 1.94 (2H, m), 2.26 (2H, t), 2.35 (2H, t), 2.98-3.16 (4H, m), 3.67 (3H, s), 3.73 (3H, s), 3.91 (2H, t), 4.82 (1H, m), 6.80 (2H, d), 6.95 (2H, d).

## EXAMPLE 37

2-S-(4-Carboxybutanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid (3-6)

3-5 (0.11 g, 0.21 mmole) was treated with LiOH (0.025 g, 1.05 mmole) as described for compound 3-4 to give the desired diacid (0.105 g).

$^1\text{H}$  NMR (300 MHz,  $\text{CD}_3\text{OD}$ )  $\delta$  1.30-1.55 (16H, m), 1.70-1.82 (4H, m), 2.20 (4H, m), 2.85 (1H, m), 3.03 (2H, m), 3.13 (1H, dd), 3.30 (1H, m), 3.92 (2H, m), 4.62 (1H, m), 6.81 (2H, d), 7.12 (2H, d).

This diacid (0.105 g) was dissolved in 30 mL EtOAc and treated with HCl gas as described for compound 2-2. The resulting solid was purified by flash chromatography on silica gel eluting with 90:8:8 ethanol/ $\text{NH}_4\text{OH}$ / $\text{H}_2\text{O}$  to provide pure 3-6 as a white solid.

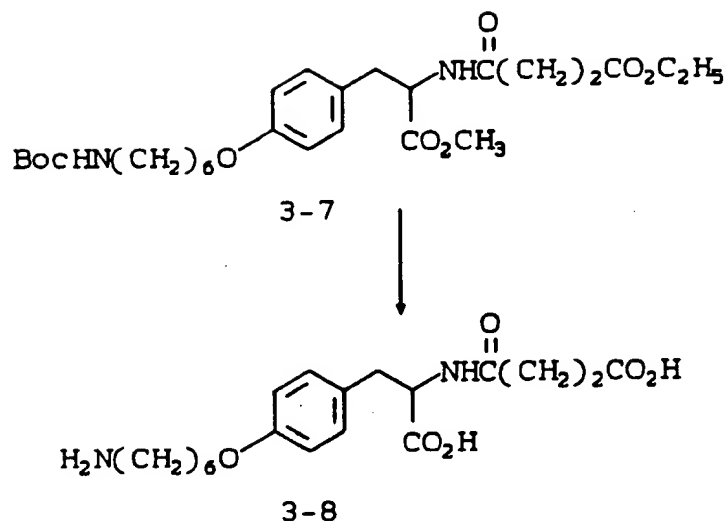
$^1\text{H}$  NMR (300 MHz,  $\text{CD}_3\text{OD}$ )  $\delta$  1.42 (2H, m), 1.50 (2H, m), 1.63 (2H, m), 1.76 (4H, m), 2.17 (4H, m), 2.85 (3H, m), 3.16 (1H, m), 4.0 (2H, t), 4.48 (1H, m), 6.78 (2H, d), 7.12 (2H, d).

Analysis for $\text{C}_{20}\text{H}_{30}\text{N}_2\text{O}_6 \cdot 1.2 \text{ H}_2\text{O}$			
Calc.:	C=57.73,	H=7.85,	N=6.73
Found:	C=57.66,	H=7.21,	N=6.83.

CCOC(=O)C(Cc1ccc(OCCN(C)C)cc1)N (3-2)
   
 ↓
   
CCOC(=O)C(Cc1ccc(OCCN(C)C)cc1)NC(=O)CCOC(=O)CC (3-7)

3-2 (0.562 g, 1.42 mmole) was dissolved in 15 mL EtOAc and treated with  $\text{NaHCO}_3$  (0.36 g, 4.27 mmole) and 3-carboethoxypropanoyl chloride (0.235 g, 1.42 mmole) with stirring overnight. The reaction mixture was diluted with 150 mL EtOAc and the organic phase was washed with  $\text{H}_2\text{O}$ , brine and dried ( $\text{Na}_2\text{SO}_4$ ). Solvent removal gave a residue that was purified by flash chromatography on silica gel eluting with 98:2  $\text{CHCl}_3/\text{CH}_2\text{OH}$  to give pure 3-7 (0.5 g).  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  1.26 (3H, t), 1.35-1.61 (16H, m), 1.76 (2H, m), 2.48 (2H, m), 2.63 (2H, m), 3.05 (2H, m), 3.11 (2H, m), 3.72 (3H, s), 3.92 (2H, t), 4.13 (2H, q), 4.82 (2H, m), 6.80 (2H, d), 7.00 (2H, d).

## EXAMPLE 39



25 2-S-(3-Carboxypropanoyl)amino-3-[4-(6-aminohexyloxy)phenyl]propionic acid hydrochloride (3-8)

3-7 (0.58 g, 1.11 mmole) was treated with LiOH as described for 3-3 to give 2-S-(carboxypropanoyl)amino-3-[4-(6-N-t-butyloxycarbonylaminohexyloxyphenyl]propionic acid (0.44 g) as a foam.

<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.32-1.58 (16H, m), 1.77 (2H, m), 2.40 (4H, m), 2.89 (1H, m), 3.0-3.16 (3H, m), 3.33 (1H, m), 3.90 (2H, t), 4.42 (1H, m), 6.78 (2H, d), 7.11 (2H, d).

This acid (0.435 g) was treated with HCl gas in EtOAc (30 mL) as described for 2-2 to give a foam that was triturated with EtOAc to give pure 3-8 (0.25 g) as a white solid.

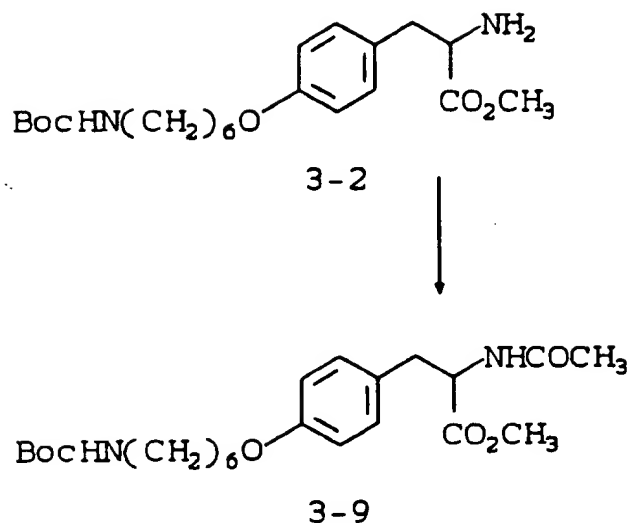
<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.4-1.6 (4H, m), 1.76 (2H, m), 2.46 (4H, m), 2.92 (3H, m), 3.14 (1H, m), 3.30 (1H, m), 3.96 (2H, m), 4.60 (1H, m), 6.81 (2H, d), 7.14 (2H, d).

35

Analysis for C <sub>19</sub> H <sub>28</sub> N <sub>2</sub> O <sub>5</sub> ·HCl·0.5 H <sub>2</sub> O			
Calc.:	C=53.58,	H=7.10,	N=6.58
Found:	C=53.18,	H=6.93,	N=6.27.

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## EXAMPLE 40



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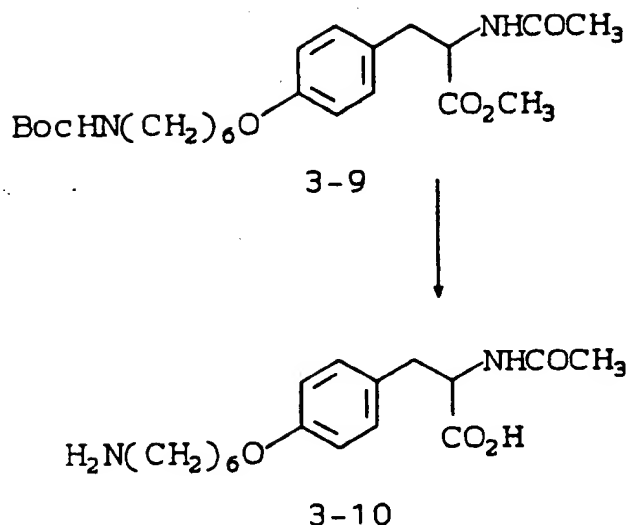
Methyl 2-S-(Acetylamino)-3-[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propionate (3-9)

3-2 (0.562 g, 1.42 mmole) was treated with acetyl chloride (0.112 g, 4.27 mmole) as described for 3-7 to give a yellow oil. This was purified by flash chromatography on silica gel eluting with 98:2 CHCl<sub>3</sub>/CH<sub>3</sub>OH to give pure 3-9 (0.58 g) as a clear oil.

<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 1.30-1.56 (14H, m), 1.78 (2H, m), 2.00 (3H, s), 3.05-3.16 (4H, m), 3.73 (3H, s), 3.92 (2H, t), 4.84 (1H, m), 6.80 (2H, d), 6.98 (2H, d).



## EXAMPLE 41



25 2-S-(Acetylamino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid hydrochloride (3-10)

3-9 (0.58 g, 1.33 mmole) was treated with LiOH (0.16 g, 6.64 mmole) as described for 3-3 to give 2-S(acetylamino)-3-[4-(6-N-t-butyloxycarbonylaminohexyloxy)phenyl]propionic acid (0.485 g) as a white solid.

<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.35-1.53 (16H, m), 1.75 (2H, m), 1.90 (3H, s), 2.86 (1H, m), 3.00-3.15 (3H, m), 3.30 (1H, m), 3.93 (2H, t), 4.59 (1H, m), 6.82 (2H, d), 7.12 (2H, d).

This compound (0.485 g) was dissolved in 30 mL EtOAc and treated with HCl gas as described for 2-2 to give a residue that was triturated with EtOAc to provide pure 3-10 (0.4 g) as a white solid.

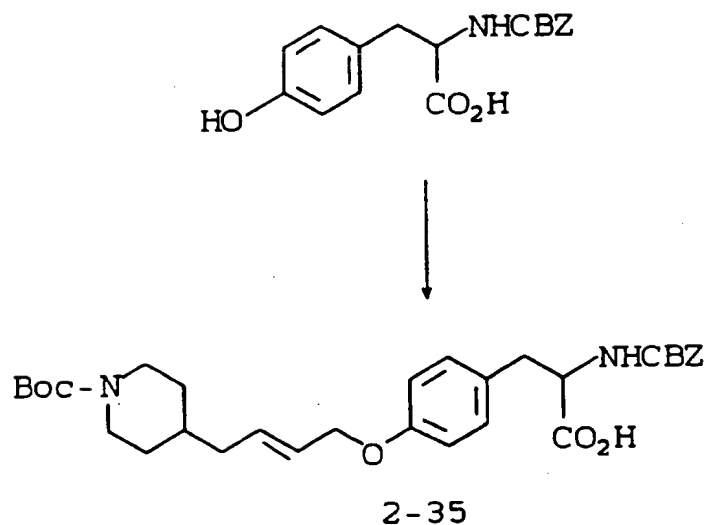
<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 1.42-1.60 (4H, m), 1.66 (2H, m), 1.70 (2H, m), 1.90 (3H, s), 2.82 (1H, m), 2.92 (2H, m), 3.12 (1H, dd), 3.30 (1H, m), 3.95 (2H, t), 4.60 (1H, m), 6.82 (2H, d), 7.13 (2H, d).

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Analysis for C <sub>17</sub> H <sub>26</sub> N <sub>2</sub> O <sub>4</sub> ·HCl·H <sub>2</sub> O			
Calc.:	C=54.17,	H=7.76,	N=7.43
Found:	C=54.30,	H=7.71,	N=7.09.

40

## EXAMPLE 42

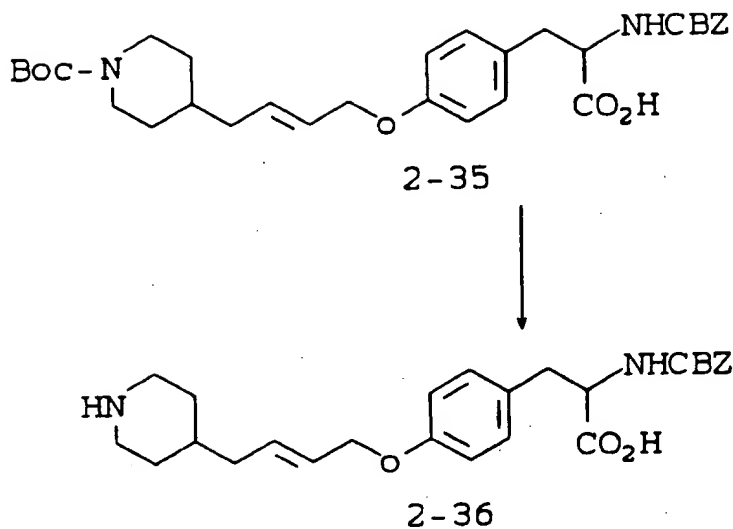


2-S-(Benzyloxycarbonylamino)-3-[4-(4-N-t-butyloxycarbonylpiperidin-4-yl)but-2-enyloxyphenyl]propionic acid (2-35)

N-CBZ-L-tyrosine (0.48 g, 0.0014 mmole) was alkylated with (4-N-t-butyloxycarbonylpiperidin-4-yl)but-2-enyl bromide (0.424 g, 1.35 mmole) as described for 2-1. Crude product was purified by flash chromatography on silica gel eluting with 97:3:1 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc to give pure 2-35 as an oil.

<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 1.00-1.21 (4H, m), 1.40-1.55 (14H, m), 2.00-2.15 (2H, m), 2.61-2.75 (2H, m), 4.02-4.14 (3H, m), 4.57 (2H, m), 4.63 (1H, m), 5.15 (2H, m), 5.32 (1H, m), 5.58 (1H, m), 5.62-5.70 (2H, m), 6.72 (2H, t), 7.00 (2H, d).

## EXAMPLE 43

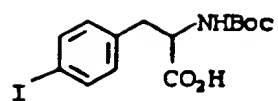
2-S-(N-Benzyloxycarbonylamino)-3-[4-(4-piperidin-4-yl)-but-2-enyloxyphenyl]propionic acid (2-36)

2-35 (0.5 g) was dissolved in 25 mL EtOAc and treated with HCl gas as described for 2-15 to provide a residue that was titrated with ether to give 2-36. A small sample was purified by HPLC to give 2-36 as the trifluoroacetate salt.

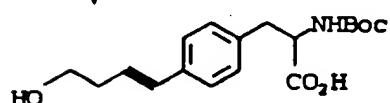
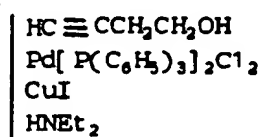
<sup>1</sup>H NMR (300 MHz, D<sub>2</sub>O) 7.2 (2H, m), 7.1 (4H, m), 6.7 (2H, d), 5.5 (2H, m), 5.1 (1H, d), 4.8 (1H, d), 4.2 (3H, bs), 3.2 (1H, d), 2.8 (3H, m), 2.25 (2H, 6t), 1.8 (2H, m), 1.4 (3H, m), 1.2 (1H, m), 0.9 (2H, m).

Analysis for C <sub>26</sub> H <sub>32</sub> N <sub>2</sub> O <sub>5</sub>			
Calc.:	C=57.87,	H=5.68,	N=4.75
Found:	C=57.98,	H=5.79,	N=4.61

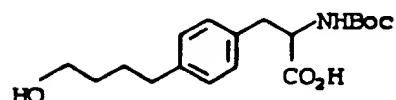
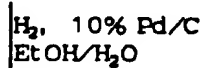
## SCHEME 4



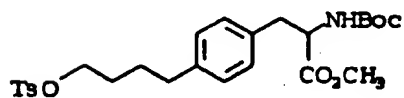
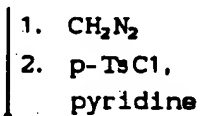
4-1



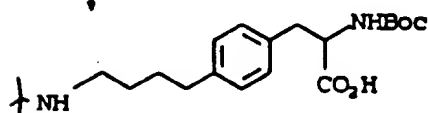
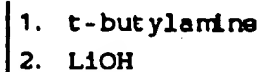
4-2



4-3



4-4

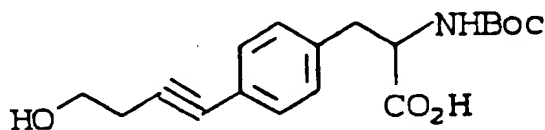


4-5

2-S-(N-t-Butyloxycarbonylamino)-3-[4-(4-hydroxybut-1-ynyl)phenyl]propionic acid (4-2)

N-BOC-4-iodo-L-phenylalanine (4-1) (1.0 g, 2.55 mmole) was dissolved in diethylamine under  $N_2$  and treated with 3-butyne-1-ol (0.23 mL, 3.06 mmole),  $[Pd(P(C_6H_5)_3)_2Cl_2]$  (0.089 g, 0.127 mmole) and CuI (0.012 g, 0.064 mmole). After 3 hours the solvent was evaporated, the residue dissolved in water (pH = 11) and extracted with ethyl acetate. The water layer was then acidified to pH 3, extracted with ethyl acetate. This organic extract was dried and evaporated to give 0.8 g crude 4-2.  $R_f = 0.47$  in 97/3/1  $CHCl_3/CH_3OH/HOAc$ , ninhydrin stain.

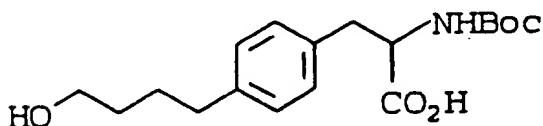
$^1H$  NMR (300 MHz,  $CDCl_3$ )  $\delta$  7.35 (2H, d), 7.1 (2H, d), 6.4 (1H, broad), 5.0 (1H, d), 4.6 (1H, m), 3.8 (2H, t), 3.1 (2H, m), 2.65 (2H, t), 1.4 (9H, s).

EXAMPLE 47

4-2

$H_2$ , 10% Pd/C

Et OH/ $H_2O$

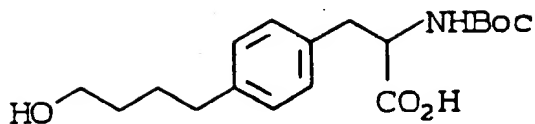


4-3

2-S-(N-t-Butyloxycarbonylamino)-3-[4-(4-hydroxybutyl)phenyl]propionic acid (4-3)

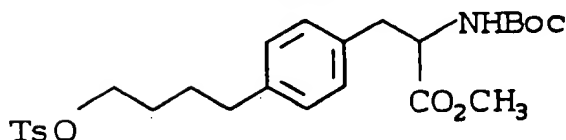
4-2 (0.40 g, 1.2 mmole) was dissolved in an ethanol/water solution (25 mL) and was treated with 10% Pd/C (0.1 g) and  $H_2$  on a Parr apparatus. After 2 hours the solution was filtered and evaporated. Column chromatography on silica gel (94:5:1  $CHCl_3/CH_3OH/HOAc$ ) yielded 0.321 g (80%) of 4-3.  $R_f = 0.57$  in 97:3:1  $CHCl_3/CH_3OH/HOAc$  ninhydrin stain.

$^1H$  NMR (300 MHz,  $CDCl_3$ )  $\delta$  7.1 (s, 4H), 4.95 (1H, m), 4.9 (1H, broad), 4.55 (1H, m), 3.65 (2H, t), 3.1 (2H, m), 1.6 (4H, m), 1.4 (9H, s).

EXAMPLE 48

4-3

1.  $\text{CH}_2\text{N}_2$   
2. p-TsCl,  
pyridine



4-4

Methyl 2-S-(N-t-Butyloxycarbonylamino)-3-[4-(4-tosyloxybutyl)phenyl]propionate (4-4)

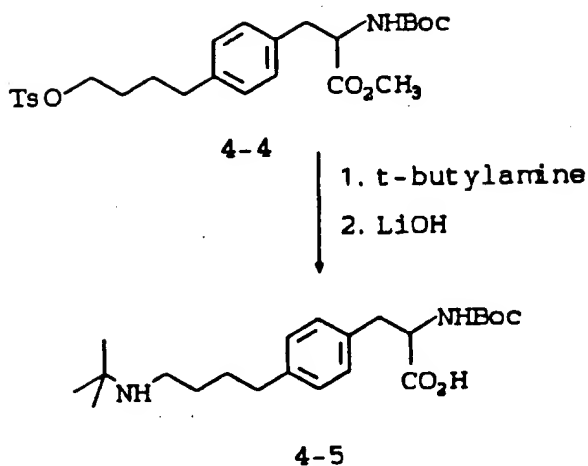
4-3 (0.285 g, 0.85 mmole) was dissolved in  $\text{CH}_2\text{Cl}_2$  (10 mL) cooled to  $0^\circ\text{C}$ , and treated with  $\text{CH}_2\text{N}_2$  solution. After 10 minutes the reaction was quenched with  $\text{MgSO}_4$ , filtered and evaporated to provide ester used in the next reaction.  $R_f=0.5$  in 92:8:1  $\text{CHCl}_3/\text{CH}_3\text{OH}/\text{HOAc}$ , ninhydrin stain.

$^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  7.05 (d,  $J=7.8$  Hz, 2H), 7.0 (d,  $J=7.8$  Hz, 2H), 5.0 (1H, m), 4.55 (1H, m), 3.69 (3H, s), 3.6 (2H,  $J=6.2$  Hz, t), 3.0 (2H, m), 2.6 (2H,  $J=7.5$  Hz, t), 1.7 (4H, m), 1.4 (9H, s).

This ester was dissolved in 10 mL  $\text{CH}_2\text{Cl}_2$  and added at  $-78^\circ\text{C}$  to a solution prepared from treating p-toluenesulfonyl chloride (0.14 g, 0.67 mmole) in  $\text{CH}_2\text{Cl}_2$  at  $-78^\circ\text{C}$  with pyridine (0.1 mL, 1.35 mmole) for 10 minutes. The reaction was allowed to warm to room temperature over 1.0 hour and then water was added. The organic layer was separated, dried, and evaporated. Column chromatography 97:3:1 on silica gel eluting with  $\text{CHCl}_3/\text{CH}_3\text{OH}/\text{HOAc}$  gave 4-4 (0.27 g, 70%).  $R_f=0.85$  97:3:1  $\text{CHCl}_3/\text{CH}_3\text{OH}/\text{HOAc}$ .

$^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ )  $\delta$  7.88 (2H,  $J=7.2$  Hz, d), 7.74 (2H,  $J=7.2$  Hz, d), 7.38 (2H,  $J=\text{Hz}$ , d), 7.30 (2H,  $J=8$  Hz, d), 5.0 (1H, m), 4.5 (1H, m), 4.0 (2H,  $J=5.3$  Hz, t), 3.67 (3H, s), 3.0 (2H, m), 2.5 (2H, t), 2.0 (3H, s), 1.6 (4H, m), 1.4 (9H, s).

## EXAMPLE 49

2-S-(N-t-Butyloxycarbonylamino)-3-[4-(4-t-butylaminobutyl)phenyl]propionic acid (4-5)

25 4-4 (0.26 g, 0.48 mmole) was dissolved in t-butylamine (5 mL) and this solution was refluxed for 2 days. The reaction was filtered and the excess t-butylamine removed at high vacuum (30°C). The residue was purified by flash chromatography on silica gel eluting with 98:2 CHCl<sub>3</sub> (saturated with NHE<sub>3</sub>)/CH<sub>3</sub>OH to give methyl 2-S-(N-t-butyloxycarbonylamino)-3-[4-(4-t-butylaminobutyl)phenyl]propionate (0.11 g, 52%) as an oil.

30 This ester (0.10 g, 2.7 mmole) was dissolved in 1:1:1 THF/CH<sub>3</sub>OH/H<sub>2</sub>O (10 mL) and LiOH·H<sub>2</sub>O (0.033 g, 1.38 mmole) was added at room temperature. After stirring for 2 hours the solvent was removed and the residue chromatographed on silica gel eluting with 9:1:1 C<sub>2</sub>H<sub>5</sub>OH/H<sub>2</sub>O/NH<sub>4</sub>OH to give pure 4-5.

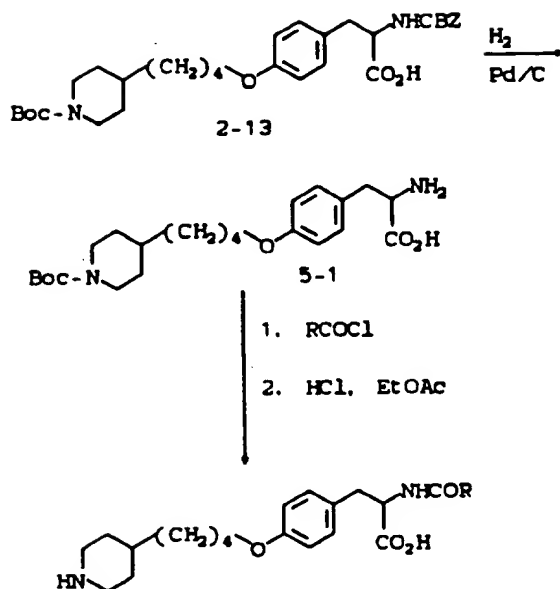
<sup>1</sup>H NMR (300 MHz, D<sub>2</sub>O) δ 7.35 (4H, s), 4.25 (1H, dd), 3.2 (1H, m), 3.1 (2H, t), 2.9 (1H, m), 2.8 (2H, t), 1.8 (4H, m), 1.4 (18H, s).

35

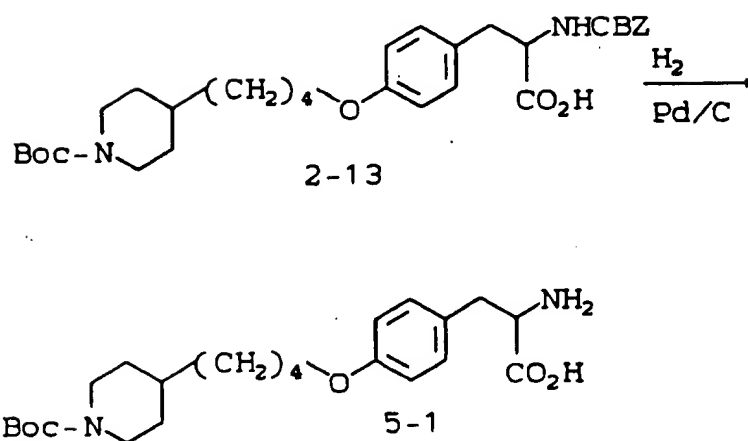
Analysis for C <sub>22</sub> H <sub>36</sub> N <sub>2</sub> O <sub>4</sub> ·1.0 CF <sub>3</sub> CO <sub>2</sub> H			
Calc.:	C=56.90,	H=7.36,	N=5.53
Found:	C=56.73,	H=7.51,	N=5.58.

40

## SCHEME 5



## EXAMPLE 50

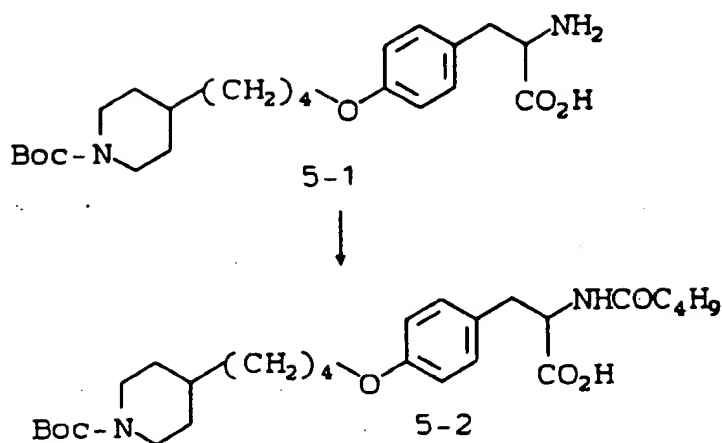
2-S-Amino-3-[4-(4-N-t-butyloxycarbonylpiperidin-4-yl)butyloxyphenyl]propionic acid (5-1)

2-13 (2.0 g) was dissolved in 100 mL EtOH, and 0.2 g 10% Pd/C was charged. This suspension was hydrogenated at balloon pressure overnight. Solvent removal provided 5-1 (1.36 g) as a white solid.

$^1\text{H}$  NMR (300 MHz,  $\text{CD}_3\text{OD}$ ),  $\delta$  0.97-1.12 (2H, m), 1.20-1.54 (14H, m), 1.72 (4H, m), 2.71 (2H, m), 2.90-3.00 (1H, m), 3.22 (1H, dd), 3.30 (1H, m), 3.71 (1H, m), 3.95-4.10 (4H, m), 6.88 (2H, d), 7.21 (2H, d).



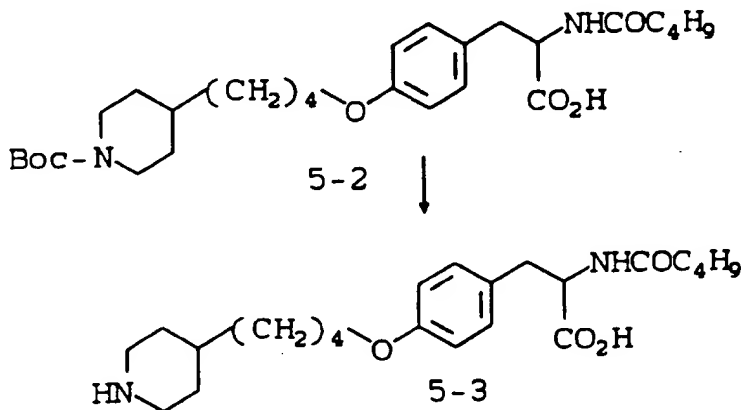
## EXAMPLE 51

2-S-(Pentanoylamino)-3-[4-(4-(N-t-butyloxycarbonylpiperidin-4-yl)butyloxy)phenyl]propionic acid (5-2)

5-1 (1.05 g, 2.5 mmole) was added to a cold solution of 1 N NaOH (2.5 mL) in 20 mL H<sub>2</sub>O and stirred at 0-10 degrees C for 5 minutes to give a clear solution. Then, pentanoyl chloride (0.332 g, 2.75 mmole) was added dropwise followed by NaHCO<sub>3</sub> (0.231 g, 2.75 mmole) and the resulting mixture was stirred vigorously at 0-10° C for 1 hour. The reaction mixture was diluted with H<sub>2</sub>O (75 mL), acidified to pH 2-3 with 10% KHSO<sub>4</sub> and extracted with EtOAc. This extract was filtered, washed with brine, dried (Na<sub>2</sub>SO<sub>4</sub>) and the solvent removed to give an oil. This was purified by flash chromatography on silica gel eluting with 97:3:1 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc to give pure 5-2 (0.44 g) as a clear oil.

<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 0.90 (3H, t), 1.20-1.62 (16H, m), 1.72 (2H, m), 2.14 (2H, m), 2.30 (8H, m), 2.65-2.90 (4H, m), 3.30 (1H, m), 3.93 (2H, m), 4.61 (1H, m), 6.81 (2H, d), 7.12 (2H, d).

## EXAMPLE 52

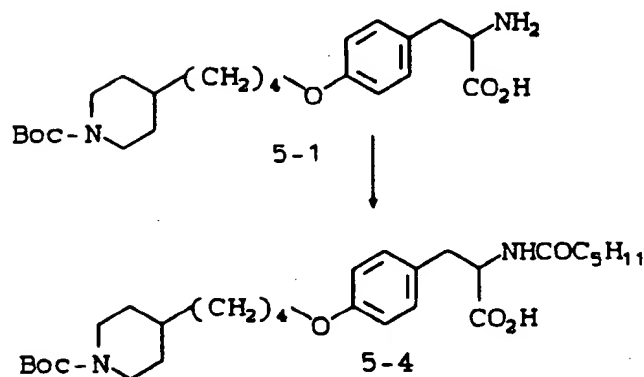
2-S-(Pentanoylamino)-3-[4-(4-piperidin-4-ylbutyloxy)phenyl]propionic acid hydrochloride (5-3)

5-2 (0.449 g), was dissolved in 30 mL EtOAc and treated with HCl gas at -10° C as described for 2-2. The resulting solid was triturated with 40 mL Et<sub>2</sub>O to give pure 5-3 (0.36 g) as a white solid.

<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 0.85 (3H, t), 1.19 (2H, m), 1.30-1.65 (9H, m), 1.73 (2H, m), 1.95 (2H, m), 2.15 (2H, m),

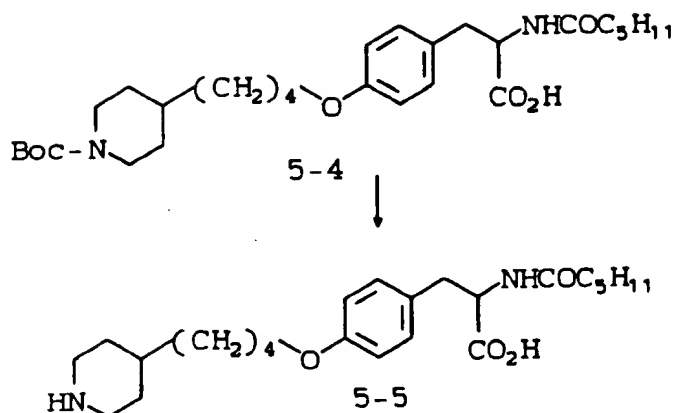
Analysis for $C_{23}H_{36}N_2O_4 \cdot HCl \cdot 0.75 H_2O$			
Calc.:	C = 60.77,	H = 8.54,	N = 6.16
Found:	C = 60.97,	H = 8.39,	N = 6.06.

### EXAMPLE 53



5-1 (0.41 g) was treated with hexanoyl chloride (0.21 mL, 1.50 mmole) as described for 5-2. Crude product was purified by flash chromatography on silica gel eluting with 97:3:1 CHCl<sub>3</sub>/CH<sub>3</sub>OH/HOAc to give pure 5-4 (0.20 g).

<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 0.85 (3H, t), 0.97-1.35 (8H, M), 1.37-1.53 (12H, m), 1.60-1.80 (4H, m), 2.13 (2H, t), 2.80 (2H, m), 2.85 (1H, m), 3.12 (1H, dd), 3.90 (2H, t), 4.04 (2H, d), 4.62 (1H, m), 6.80 (2H, d), 7.12 (2H, d).



**2-S-(Hexanoylamino)-3-[4-(4-piperidin-4-ylbutoxy)phenyl]propionic acid (5-5)**

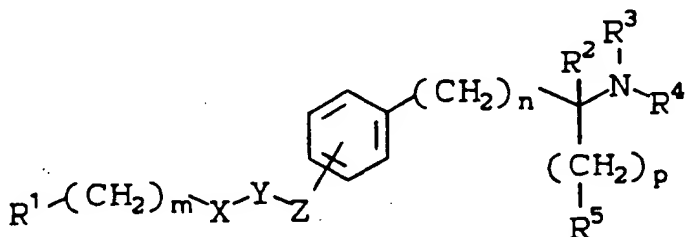
5-4 (0.199 g) was dissolved in 25 mL EtOAc and treated with HCl gas as described for compound 2-2 to provide pure 5-5 (48 mg).

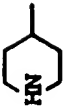

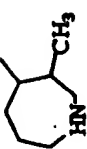

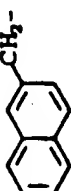


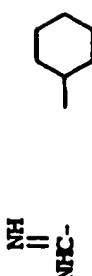

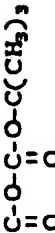
<sup>1</sup>H NMR (300 MHz, CD<sub>3</sub>OD) δ 0.84 (3H, t), 1.08-1.20 (4H, m), 1.35 (4H, m), 1.52 (4H, m), 1.77 (2H, m), 1.92 (2H, d), 2.16 (2H, t), 2.80-3.2 (3H, m), 3.15 (1H, dd), 3.40-3.52 (2H, m), 3.92 (2H, t), 4.61 (1H, m), 6.81 (2H, d), 7.13 (2H, d).

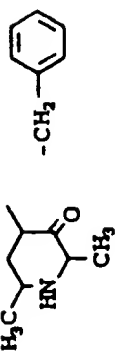


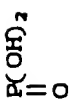


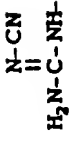

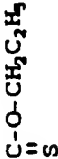

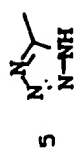



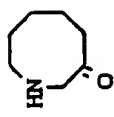



Analysis for $C_{26}H_{39}N_2O_6F_3 \cdot 0.55 H_2O \cdot 0.30 TFA$			
Calc.:	C = 55.39,	H = 7.06,	N = 4.86
Found:	C = 55.38,	H = 7.03,	N = 4.85.

Sample alternative protecting groups that can be used in the preparation of the present invention include benzyl ester, cyclohexyl ester, 4-nitrobenzyl ester, t-butyl ester, 4-pyridylmethyl ester, benzyloxycarbonyl, isonicotinylloxycarbonyl, O-chlorobenzyloxycarbonyl, p-nitrobenzyloxycarbonyl, p-methoxybenzyloxycarbonyl, t-butoxycarbonyl, t-amylloxycarbonyl, isobornylloxycarbonyl, adamantylloxycarbonyl, 2-(4-biphenyl)-2-propyloxycarbonyl and 9-fluorenylmethoxycarbonyl.

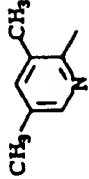

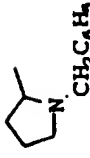




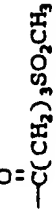
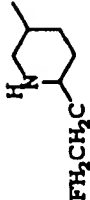


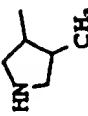
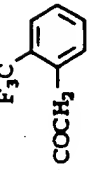

In addition to those compounds specifically exemplified above, additional compounds of the present invention are set forth in tabular form below. These compounds are synthesized by use of the synthetic routes and methods described in the above Schemes and Examples and variations thereof well known to those of ordinary skill in the art, and not requiring undue experimentation. All variables listed in the Tables below are with reference to the following generic structure:

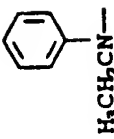
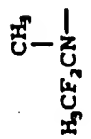

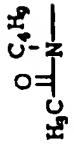









Example	R <sup>1</sup>	R <sup>2</sup>	R <sup>3</sup>	R <sup>4</sup>	R <sup>5</sup>	X	Y	Z	m	n	p
55		H	H	-CH <sub>2</sub> C <sub>6</sub> H <sub>5</sub>	CO <sub>2</sub> H	CH <sub>2</sub>	0	0	3	1	1
56		H	CH <sub>3</sub>	COCH <sub>3</sub>	CO <sub>2</sub> H	CH <sub>2</sub>	0	-	3	1	1
57		CH <sub>2</sub> OCH <sub>3</sub>	CH <sub>2</sub> C <sub>6</sub> H <sub>5</sub>	COC <sub>2</sub> H <sub>5</sub>	CO <sub>2</sub> H <sub>3</sub>	CH <sub>2</sub>	CH <sub>2</sub>	CH <sub>2</sub>	4	2	1
58		(CH <sub>2</sub> ) <sub>2</sub> C <sub>6</sub> H <sub>5</sub>		COCH <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub>	COCH <sub>3</sub>	CH <sub>2</sub>	CH <sub>2</sub>	-	5	3	1
59		H	(CH <sub>2</sub> ) <sub>2</sub> OCH <sub>2</sub> CH <sub>3</sub>	(CH <sub>2</sub> ) <sub>2</sub> C <sub>6</sub> H <sub>5</sub>		CH <sub>2</sub>	0	CH <sub>2</sub>	2	2	2
60			H	CO(CH <sub>2</sub> ) <sub>2</sub> OCH <sub>3</sub>		CH <sub>2</sub>	CH <sub>2</sub>	-	3	1	1

Example	R <sup>1</sup>	R <sup>2</sup>	R <sup>3</sup>	R <sup>4</sup>	R <sup>5</sup>	X	Y	Z	m	n	p
61			C <sub>6</sub> H <sub>5</sub>	COO(CH <sub>2</sub> ) <sub>2</sub> C <sub>6</sub> H <sub>5</sub>	CO <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub>	CH <sub>3</sub>	0	-	2	3	1
62		CH <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>	(CH <sub>2</sub> ) <sub>2</sub> SO <sub>2</sub> CH <sub>3</sub>	CH <sub>2</sub> SO <sub>2</sub> CH <sub>2</sub> C <sub>2</sub> H <sub>5</sub>		CHOH	0	-	3	1	1
63		H	(CH <sub>2</sub> ) <sub>2</sub> CN	H	CONHCH <sub>2</sub> CO <sub>2</sub> CH <sub>3</sub>	NH		-	0	6	2
64		C <sub>6</sub> H <sub>5</sub>	(CH <sub>2</sub> ) <sub>2</sub> NO <sub>2</sub>			NCH <sub>3</sub>		-	2	0	10
65			CF <sub>3</sub> CF <sub>3</sub>			O	CH <sub>2</sub>	-	3	1	1
66			(CH <sub>2</sub> ) <sub>2</sub> NHCH <sub>3</sub>			SO <sub>2</sub>	CH=CH	-	1	2	3

Example	R <sup>1</sup>	R <sup>2</sup>	R <sup>3</sup>	R <sup>4</sup>	R <sup>5</sup>	X	Y	Z	m	n	p
67			$(\text{CH}_2)_4\text{SCH}_2\text{CH}_3$	$\text{COCH}_2\text{C}_6\text{H}_5$	$\text{O}=\text{P}(\text{OH})_2$	$\text{CH}_3$	$\text{C}=\text{S}$	$\text{CH}_2$	4	2	1
68			$(\text{CH}_2)_4$ -		$\text{O}=\text{P}(\text{OH})_2$	$\text{C}=\text{O}$	0	-	3	3	0
69		$\text{CH}_2\text{SC}_6\text{H}_5$	$(\text{CH}_2)_3\text{CO}_2\text{CH}_3$	$\text{COC}_3\text{H}_7$	$-\text{C}(\text{O})_2\text{O}-\text{C}(\text{O})_2\text{CH}_3$	$\text{C}=\text{S}$	$\text{NHCH}_3$	-	4	1	3
70		$\text{CH}_3\text{CH}_2\text{SO}_2\text{CH}_3$	$(\text{CH}_2)_2\text{CO}_2\text{H}$		$-\text{C}(\text{O})_2\text{O}-\text{C}_2\text{H}_5$	$\text{CH}_3$	$\text{C}=\text{S}$	$\text{CH}_2$	3	4	1
71		$\text{CH}_3\text{CH}_2\text{NHCH}_3$	$(\text{CH}_2)_3\text{NH}(\text{CH}_2)_2\text{OCH}_3$	$\text{COOC}_{10}\text{H}_{21}$		$\text{CH}_3$	$\text{SO}_2$	-	2	2	2

Example	R <sup>1</sup>	R <sup>2</sup>	R <sup>3</sup>	R <sup>4</sup>	R <sup>5</sup>	X	Y	Z	m	n	p
72		CH <sub>3</sub>		H	CO <sub>2</sub> H	CH <sub>2</sub>	NOCH <sub>3</sub>	-	1	1	1
73		C <sub>2</sub> H <sub>5</sub>		(CH <sub>2</sub> ) <sub>2</sub> CO <sub>2</sub> H		O	C=O	0	3	2	1
74		C <sub>3</sub> H <sub>7</sub>			COOC <sub>2</sub> H <sub>5</sub>	CH <sub>2</sub>	SO <sub>2</sub>	CH <sub>2</sub>	1	0	4
75		C <sub>4</sub> H <sub>9</sub>	C <sub>3</sub> H <sub>7</sub>			CH <sub>2</sub>	CH <sub>2</sub>	0	3	1	3
76		CH <sub>2</sub> C <sub>6</sub> H <sub>5</sub>	C <sub>10</sub> H <sub>21</sub>			CH=CH	CH <sub>2</sub>	-	2	2	2

Example	R <sup>1</sup>	R <sup>2</sup>	R <sup>3</sup>	R <sup>4</sup>	R <sup>5</sup>	X	Y	Z	m	n	p
77		(CH <sub>2</sub> ) <sub>3</sub> C <sub>6</sub> H <sub>5</sub>	(CH <sub>2</sub> ) <sub>3</sub> -SO <sub>2</sub> -C <sub>6</sub> H <sub>5</sub>	CH <sub>2</sub> (CH <sub>2</sub> ) <sub>3</sub> CO <sub>2</sub> CH <sub>3</sub>	-COOC <sub>6</sub> H <sub>5</sub>	CH <sub>3</sub>	-C	-	1	2	4
78		(CH <sub>2</sub> ) <sub>3</sub> C <sub>6</sub> H <sub>5</sub>	CH <sub>2</sub> CH <sub>2</sub> F	-C-(CH <sub>2</sub> ) <sub>2</sub> OCH <sub>3</sub>		-C=C-	CH <sub>3</sub>	0	4	2	1
79		(CH <sub>2</sub> ) <sub>3</sub> -NHCOOH	CH <sub>3</sub>		-CO <sub>2</sub> CH <sub>2</sub> C <sub>6</sub> H <sub>5</sub>		CH <sub>3</sub>	-	3	2	0
80	C <sub>6</sub> H <sub>5</sub> (CH <sub>2</sub> ) <sub>2</sub> NH-	(CH <sub>2</sub> ) <sub>3</sub> SC <sub>6</sub> H <sub>5</sub>	C <sub>2</sub> H <sub>5</sub>			CH <sub>3</sub>	CH <sub>3</sub>	-	0	2	3
81		CH <sub>2</sub> - 	(CH <sub>2</sub> ) <sub>2</sub> CH <sub>2</sub> NO <sub>2</sub>	CH <sub>3</sub>		CH <sub>3</sub>	CH <sub>3</sub>	-	1	1	1

The test procedures employed to measure the anti-platelet aggregating activity of the compounds of the present invention are described below.



## EXAMPLE 82

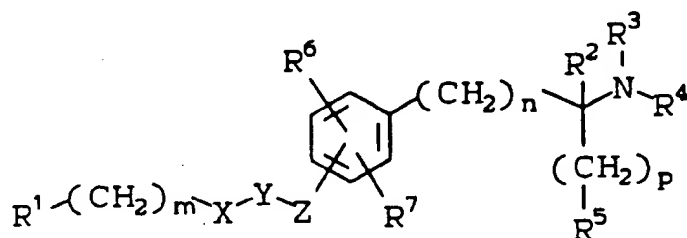
Blood was drawn into 0.1 volumes of acid-citrate-dextrose (85 mM sodium citrate, 64 mM citric acid, 110 mM dextrose) by venipuncture from normal human volunteers. Platelet-rich plasma was prepared by centrifugation at 400 x g for 12 minutes. PGE1 (5 mg/ml) was added and platelets were collected by centrifugation at 800 x g for 12 minutes. The platelet pellet was resuspended into human platelet buffer (140 mM NaCl, 7.9 mM KCl, 3.3 mM Na<sub>2</sub>HPO<sub>4</sub>, 6 mM HEPES, 2% bovine serum albumin, 0.1 % dextrose, pH 7.2) and filtered over Sepharose 2B that was previously equilibrated in human platelet buffer. Platelets were counted and adjusted to 2 x 10<sup>8</sup>/ml with human platelet buffer. Human fibrinogen (10-100 mg/ml and CaCl<sub>2</sub> (1 mM) were added and aggregation was initiated by the addition of 10 mM ADP. Aggregation was monitored by the initial rate of increase of light transmittance.

While the invention has been described and illustrated in reference to certain preferred embodiments thereof, those skilled in the art will appreciate that various changes, modifications and substitutions can be made therein without departing from the spirit and scope of the invention. For example, effective dosages other than the preferred doses as set forth hereinabove may be applicable as a consequence of variations in the responsiveness of the mammal being treated for severity of clotting disorders or emboli, or for other indications for the compounds of the invention indicated above. Likewise, the specific pharmacological responses observed may vary according to and depending upon the particular active compound selected or whether there are present pharmaceutical carriers, as well as the type of formulation and mode of administration employed, and such expected variations or differences in the results are contemplated in accordance with the objects and practices of the present invention. It is intended, therefore, that the invention be limited only by the scope of the claims which follow and that such claims be interpreted as broadly as is reasonable.

## Claims

Claims for the following Contracting States : AT, BE, CH, DE, DK, FR, GB, IT, LI, LU, NL, SE

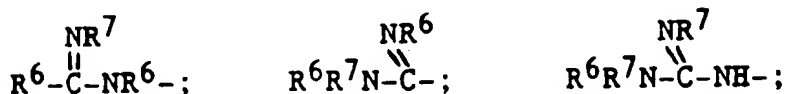
1. A compound of the formula

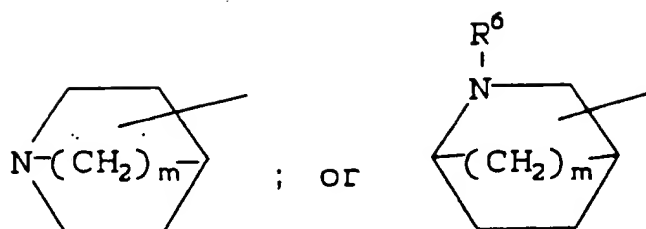


I

and the pharmaceutically acceptable salts thereof,  
wherein

R<sup>1</sup> is  
a four to eight member heterocyclic ring containing 1, 2, 3 or 4 hetero atoms wherein said heteroatoms are N, O or S and wherein said heterocyclic ring is optionally substituted at any atom by H, R<sup>6</sup> or R<sup>7</sup>;



NR<sup>6</sup>R<sup>7</sup>

wherein R<sup>6</sup> and R<sup>7</sup> are independently hydrogen,  
C<sub>1-10</sub> alkoxycarbonyl or unsubstituted or substituted C<sub>1-10</sub> alkyl and cycloalkyl wherein said substituents

are

- 20 C<sub>1-10</sub> alkoxy,  
C<sub>1-10</sub> alkoxyalkyl,  
C<sub>1-10</sub> alkoxyalkyloxy,  
C<sub>1-10</sub> alkoxycarbonyl,  
C<sub>1-10</sub> alkylcarbonyl,  
C<sub>0-6</sub> alkylaminocarbonyl,  
25 C<sub>1-10</sub> aralkylcarbonyl,  
C<sub>1-10</sub> alkylthiocarbonyl,  
C<sub>4-10</sub> aralkylthiocarbonyl, thiocarbonyl,  
C<sub>1-10</sub> alkoxythiocarbonyl, aryl,  
5 to 6 membered saturated heterocyclic rings of 1, 2, 3 or 4 hetero atoms wherein said  
30 hetero atoms are taken from the group consisting of N, O and S,  
C<sub>1-4</sub> alkanoylamino,  
C<sub>1-6</sub> alkoxycarbonyl-C<sub>0-6</sub> alkylamino,  
C<sub>1-10</sub> alkylsulfonylamino,  
C<sub>4-10</sub> aralkylsulfonylamino,  
35 C<sub>4-10</sub> aralkyl,  
C<sub>1-10</sub> alkaryl,  
C<sub>1-10</sub> alkylthio,  
C<sub>4-10</sub> aralkylthio,  
C<sub>1-10</sub> alkylsulfinyl,  
40 C<sub>4-10</sub> aralkylsulfinyl,  
C<sub>1-10</sub> alkylsulfonyl,  
C<sub>4-10</sub> aralkylsulfonyl, aminosulfonyl,  
C<sub>1-10</sub> alkylaminosulfonyl,  
C<sub>4-10</sub> aralkylsulfonylamino,  
45 oxo,  
thio,  
unsubstituted or mono- or di-substituted 1-ethenyl, 2-ethenyl or 3-propenyl wherein said  
substituents are selected from the group consisting of hydrogen, C<sub>1-10</sub> alkyl and C<sub>7-10</sub>  
50 aralkyl,  
carboxy,  
hydroxy,  
amino,  
C<sub>1-6</sub> alkylamino,  
C<sub>1-6</sub> dialkylamino,  
55 halogen, where halogen is defined as  
Cl, F, Br, or I,  
nitro, or  
cyano,

and further wherein said N can additionally be substituted to form a quaternary ammonium ion wherein said substituent is as previously defined for R<sup>6</sup> and R<sup>7</sup>;

R<sup>2</sup> and R<sup>3</sup>

are independently

hydrogen,

aryl or

unsubstituted or substituted C<sub>0-10</sub> alkyl or cycloalkyl wherein said substituent is

C<sub>1-10</sub> alkoxyalkyl,

aryl,

a 4 to 8 membered heterocyclic ring containing 1, 2, 3 or 4 hetero atoms, wherein said hetero atoms are taken from the group consisting of N, O and S,

C<sub>4-10</sub> aralkyl,

C<sub>1-10</sub> alkaryl,

carboxy,

C<sub>1-10</sub> alkylcarbonyl,

C<sub>1-10</sub> alkylthiocarbonyl,

C<sub>4-10</sub> aralkylcarbonyl,

C<sub>4-10</sub> aralkylthiocarbonyl,

C<sub>1-6</sub> alkoxy carbonyl,

C<sub>4-10</sub> aralkoxy carbonyl,

C<sub>1-6</sub> alkoxy,

C<sub>4-10</sub> aralkoxy,

C<sub>1-6</sub> alkylamino,

C<sub>1-12</sub> dialkylamino,

C<sub>1-6</sub> alkanoylamino,

C<sub>4-12</sub> aralkanoylamino,

C<sub>4-10</sub> aralkylamino;

R<sup>4</sup>

is

hydrogen,

aryl,

C<sub>1-10</sub> alkyl or cycloalkyl

C<sub>4-10</sub> aralkyl,

arylcarbonyl, aminocarbonyl,

C<sub>1-10</sub> alkylcarbonyl, C<sub>1-6</sub>alkylaminocarbonyl,

C<sub>1-10</sub> alkylthiocarbonyl, C<sub>1-6</sub>dialkylaminocarbonyl,

C<sub>1-10</sub> alkoxythiocarbonyl, arylC<sub>1-6</sub>alkylaminocarbonyl,

C<sub>1-10</sub> alkoxy carbonyl,

C<sub>4-10</sub> aralkylcarbonyl,

C<sub>4-10</sub> aralkoxy carbonyl,

C<sub>1-10</sub> carboxylalkyl and

further wherein any of the substituents for R<sup>4</sup> may be substituted by one or more substituents selected from the group as defined for R<sup>6</sup>, or an L- or D-amino acid joined by an amide linkage;

R<sup>5</sup>

is

a four to eight membered saturated or unsaturated heterocyclic ring containing 1, 2, 3 or 4 hetero atoms wherein said hetero atoms are N, O, or S or,



wherein R<sup>8</sup> is

hydroxy,

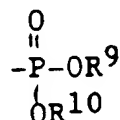
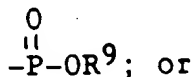
C<sub>1-10</sub> alkyloxy,

C<sub>1-10</sub> alkaryloxy,

C<sub>4-10</sub> aralkyloxy,

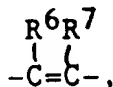
C<sub>4-10</sub> aralkylcarbonyloxy,

$C_{1-10}$  alkoxyalkyloxy,  
 $C_{1-10}$  alkoxyalkylcarbonyloxy,  
 $C_{1-10}$  alkoxycarbonyloxyalkyl,  
 $C_{1-10}$  alkylcarbonyloxyalkyloxy,  
 an L- or D-amino acid joined by an amide linkage, and wherein the carboxylic acid moiety of said amino acid is as the free acid or is esterified by  $C_{1-6}$ alkyl.

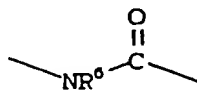
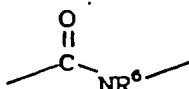


wherein  $R^9$  and  $R^{10}$  are selected from the group consisting of hydrogen,  $C_{1-10}$  alkyl and  $C_{4-10}$  aralkyl;

X and Y are optional substituents that, when present, are  $\text{NR}^6$ ,  
 O,  
 S,  
 SO,  
 SO<sub>2</sub>,



$-\text{C}=\text{C}-$ ,  
 oxo,  
 aryl,  
 thiono,  
 unsubstituted or substituted  $C_{1-15}$  alkyl or cycloalkyl wherein said substituents are independently  $R^6$  and  $R^7$ ,



$-\text{NR}^6-\text{SO}_2-$ ,  $-\text{SO}_2-\text{NR}^6-$ , or a 4- to 8- membered heterocyclic ring containing 1, 2, 3, or 4 heteroatoms wherein said atoms are N, O, or S and wherein said ring is independently substituted at any atom with  $R^6$ ;

Z is an optional substituent that, when present, is independently chosen as defined by X and Y;

m is an integer of from zero to ten;

n is an integer of from zero to ten; and

p is an integer of from zero to three;

with the exception of:

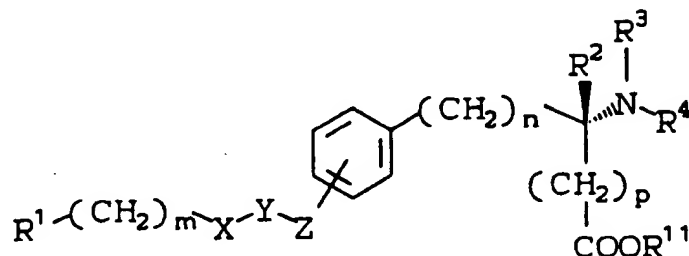
N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine;

N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine;

N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminoethyl)-L-tyrosine; and

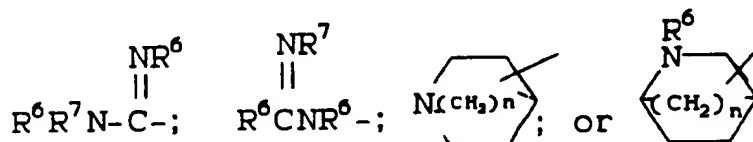
$\alpha$ -benzoylamino-4-(2-diethylaminoethoxy)benzenepropanoic acid.

2. A compound of the structural formula



and the pharmaceutically acceptable salts thereof,  
wherein

$R^1$  is  
a four to eight member heterocyclic ring containing 1, 2, 3 or 4 hetero atoms wherein said heteroatoms  
are N, O, or S and wherein said heterocyclic ring is optionally substituted by hydrogen,  $C_{1-10}$  alkyl;  
or  
 $NR^6R^7$  wherein  $R^6$  and  $R^7$  are independently hydrogen,  
 $C_{1-10}$  alkoxy, unsubstituted or substituted  $C_{1-10}$  alkyl wherein said substituent is  
 $C_{1-10}$  alkoxy,  
 $C_{1-10}$  alkoxy, aryl,  
 $C_{4-10}$  aralkyl,  
 $C_{1-10}$  alkaryl,  
carboxy,  
hydroxy or  
amino,



and further wherein said N can additionally be substituted to form a quaternary ammonium ion;

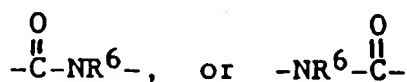
$R^2$  and  $R^3$  are independently  
hydrogen or  
 $C_{1-10}$  alkyl; or  
 $C_{4-10}$  aralkyl;

$R^4$  is  
hydrogen,  
 $C_{1-10}$  alkyl,  
 $C_{4-10}$  aralkyl,  
arylcarbonyl,  
aralkylcarbonyl,  
 $C_{1-10}$  alkylcarbonyl,  
 $C_{1-10}$  alkoxy, carbonyl,

C<sub>4-10</sub> aralkylcarbonyl,  
 C<sub>4-10</sub> aralkoxycarbonyl or  
 and further wherein any of the substituents for R<sup>4</sup> may be substituted by one or more substituents  
 from the group defined as R<sup>6</sup> in Claim 1;

R<sup>11</sup> is  
 hydrogen or  
 C<sub>1-10</sub> alkyl;

X and Y are independently  
 O,  
 S, SO  
 SO<sub>2</sub>,  
 aryl,  
 -CH=CH-,  
 oxo,



-NR<sup>6</sup>SO<sub>2</sub>-; -SO<sub>2</sub>NR<sup>6</sup>-  
 unsubstituted or substituted C<sub>1-15</sub> straight or branched alkyl either substituted or unsubstituted with  
 carboxy,  
 hydroxy,  
 C<sub>1-10</sub> alkoxy, or  
 a 4- to 6- membered heterocyclic ring containing 1, 2 or 3 heteroatoms chosen from N, O or S,

Z is an optional substituent that, when present, is O, SO<sub>2</sub>, -NR<sup>6</sup>CO-, -CONR<sup>6</sup>;



C<sub>1-10</sub> straight or branched alkyl;

m is an integer of from zero to six;

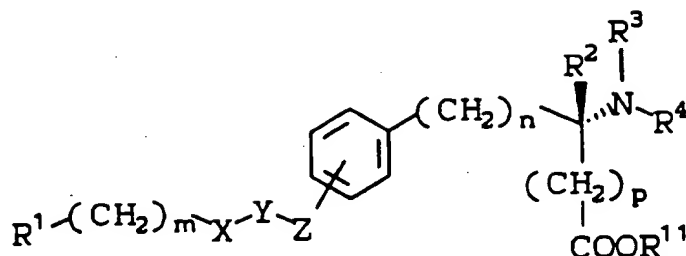
n is an integer of from zero to six; and

p is an integer of from zero to three;

with the exception of:

N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine;  
 N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine;  
 N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminoethyl)-L-tyrosine; and  
 α-benzoylamino-4-(2-diethylaminoethoxy)benzenepropanoic acid.

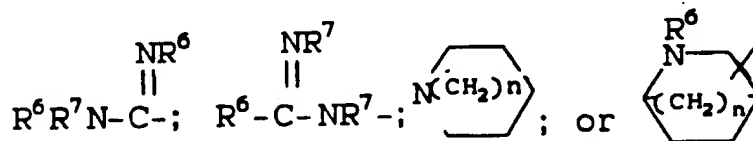
3. A compound of the structural formula



and the pharmaceutically acceptable salts thereof,  
wherein

R¹ is  
a five to six member heterocyclic ring containing 1 or 2 heteroatoms wherein said heteroatoms  
are N and wherein said heterocyclic ring is optionally substituted by C₁-₅ alkyl; or

NR⁶R⁷ wherein R⁶ and R⁷ are independently hydrogen,  
unsubstituted or substituted C₁-₁₀ alkyl wherein said substituent is  
C₁-₁₀ alkoxy, carbonyl, aryl,  
C₁-₁₀ aralkyl,



and further wherein said N can additionally be substituted to form a quaternary ammonium ion;

R² and R³ are hydrogen;

R⁴ is  
arylcabonyl,  
C₁-₁₀ alkylcarbonyl,  
aralkylcarbonyl  
C₁-₁₀ alkoxy, carbonyl,  
C₄-₁₀ aralkylcarbonyl,  
C₄-₁₀ aralkoxy, carbonyl or  
and further wherein the substituents for R⁴ may be unsubstituted by one or more substituents from  
the group defined as R⁶ in Claim 1;

R¹¹ is  
hydrogen or  
C₁-₁₀ alkyl;

X and Y are independently  
O, SO₂, aryl; NR⁶CO-; -CONR⁶-CH=CH-,  
unsubstituted or substituted C₁-₁₅ straight or branched alkyl wherein said substituent is hydroxy, or  
a 4- to 6- membered heterocyclic ring containing 1 or 2 heteroatoms chosen from N, O or S;

Z is an optional substituent that, when present, is O or  
C₁-₁₀ straight or branched alkyl;

m is an integer of from zero to six;  
 n is an integer of from zero to one; and  
 5 p is an integer of from zero to one;

with the exception of:

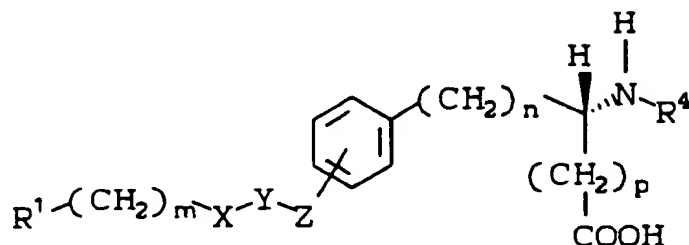
N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine;

N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine;

10 N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminoethyl)-L-tyrosine; and

$\alpha$ -benzoylamino-4-(2-diethylaminoethoxy)benzenepropanoic acid.

4. A compound of the structural formula



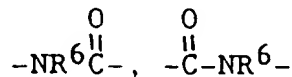
and the pharmaceutically acceptable salts thereof,  
 wherein

30 R¹ is  
 a six member saturated heterocyclic ring containing 1 or 2 heteroatoms wherein said heterocyclic  
 atoms are N and wherein said heterocyclic ring is optionally substituted by C₁-₅ alkyl; or

NR⁶R⁷ wherein R⁶ and R⁷ are independently hydrogen or C₁-₁₀ alkyl;

35 R⁴ is  
 arylcarbonyl,  
 C₁-₁₀ alkylcarbonyl,  
 C₄-₁₀ aralkylcarbonyl  
 40 C₁-₁₀ alkoxy carbonyl,  
 C₄-₁₀ aralkylcarbonyl or  
 C₄-₁₀ aralkoxy carbonyl,  
 and further wherein any of the substituents for R⁴ may be substituted by one or more substituents  
 from the group defined as R⁶ in Claim 1,

45 X and Y  
 are independently  
 O, SO₂, aryl,



-CH=CH- or  
 55 C₁-₁₀ straight or branched alkyl;

Z is an optional substituent that, when present, is O or  
 C₁-₅ straight or branched alkyl;



m is an integer of from zero to six;

n is one; and

p is zero;

with the exception of:

N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine

N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine;

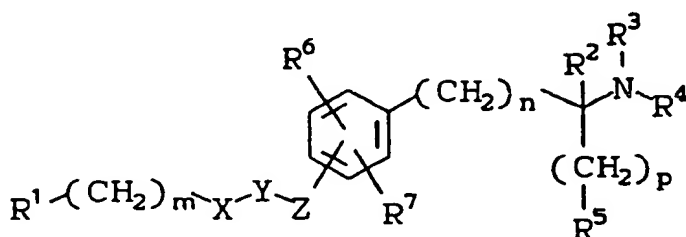
N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminoethyl)-L-tyrosine; and

$\alpha$ -benzoylamino-4-(2-diethylaminoethoxy)benzenepropanoic acid.

5. A compound as claimed in Claim 1, selected from the group consisting of:

- 2-S-(6-N-Benzyloxycarbonylamino)-3-[4-(3-chloropropoxy)phenyl] propionic acid;
- 2-S-(N-Benzyloxycarbonylamino)-3-[4-(N,N,2,2-tetramethyl-1,3-propanediamino)propyloxyphenyl]propionic acid;
- 2-S-(N-Benzyloxycarbonylamino)-3-[4-(3-N-pyrrolidinylpropyloxy)phenyl]propionic acid ;
- 2-S-(N-Benzyloxycarbonylamino)-[4-(3-N-methyl-N-benzylaminopropyloxyphenyl)]propionic acid;
- 2-S-(N-Benzyloxycarbonylamino)-3-[4-(4-piperazinyl)butyloxyphenyl]propionic acid;
- 2-S-(N-Benzyloxycarbonylamino)-3-[4-(1,1,4,4-tetramethylbutylamino)propyloxyphenyl]propionic acid;
- 2-S-(N-Benzyloxycarbonyl)-3-[4-(4-methylpiperazin-1-yl)propyloxyphenyl]propanoic acid;
- 2-(N-Benzyloxycarbonylamino)-3-[4-(5-bromopentyloxy)phenyl]propionic acid ;
- 2-S-(N-Benzyloxycarbonylamino)-3-[4-(4-piperazin-1-yl)pentyloxyphenyl]propionic acid;
- 2-S-(N-Benzyloxycarbonylamino)-3-[4-(6-aminohexyloxyphenyl)]propionic acid hydrochloride;
- 2-S-(N-Benzyloxycarbonylamino)-3-[4-(7-aminoheptyloxy)phenyl]propionic acid hydrochloride;
- 2-S-(N-Benzyloxycarbonylamino)-3-[4-(8-aminooctyloxy)phenyl]propionic acid;
- 2-S-(N-Benzyloxycarbonylamino)-3-[4-(5-aminopentyloxy)phenyl]propionic acid hydrochloride;
- 2-S-(N-Benzyloxycarbonylamino)-3-[4-(4-piperidinyl)butyloxy]phenyl]propionic acid;
- 2-S-Phenylcarbonylamino-3-[4-(6-aminohexyloxy)phenyl]propionic acid hydrochloride;
- 2-S-Phenethylcarbonylamino-3-[4-(6-aminohexyloxy)phenyl]propanoic acid hydrochloride;
- 2-S-(Phenylacetyl)amino-3-[4-(6-aminohexyloxy)phenyl]propionic acid;
- 2-S-(2-Carboxy-3-phenylpropionyl)amino-3-[4-(6-aminohexyloxy)phenyl]propionic acid;
- 2-S-(Hexanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid Hydrochloride;
- 2-S-(Naphthanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid;
- 2-S-(Butanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid;
- 2-S-(Heptanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid hydrochloride ;
- 2-(S)-(5-Phenylpentanoylamino)-3-[4-(6-t-butyloxycarbonylamino)hexyloxy]phenyl]propionic acid;
- 2-S-(5-Phenylpentanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionic acid hydrochloride;
- 2-S-(3-Carboxypropanoyl)amino-3-[4-(6-aminohexyloxy)phenyl]propionic acid hydrochloride;
- 2-S-(Acetyl)amino-3-[4-(6-aminohexyloxy)phenyl]propionic acid hydrochloride;
- 2-S-(N-Benzyloxycarbonylamino)-3-[4-(4-piperidinyl)but-2-enyloxyphenyl]propionic acid;
- 2-S-(N-t-Butyloxycarbonylamino)-3-[4-(4-hydroxybut-1-ynyl)phenyl]propionic acid;
- 2-S-(N-t-Butyloxycarbonylamino)-3-[4-(4-hydroxybutyl)phenyl]propionic acid;
- 2-S-(N-t-Butyloxycarbonylamino)-3-[4-(4-t-butylaminobutyl)phenyl]propionic acid;
- 2-S-(Pentanoylamino)-3-[4-(4-piperidin-4-yl)butyloxy]phenyl]propionic acid hydrochloride;
- 2-S-(Hexanoylamino)-3-[4-(4-piperidin-4-yl)butyloxy]phenyl]propionic acid;
- 2-S-(5-Aminopentanoyl)amino-3-[4-(6-aminohexyloxy)phenyl]]propionic acid dihydrochloride;
- Methyl 2-S-(4-Carbomethoxybutanoyl)amino-3-[4-(N-t-butyloxycarbonylamino)hexyloxy]phenyl]propionate; and
- 2-S-(4-Carboxybutanoylamino)-3-[4-(6-aminohexyloxy) phenyl]propionic acid.

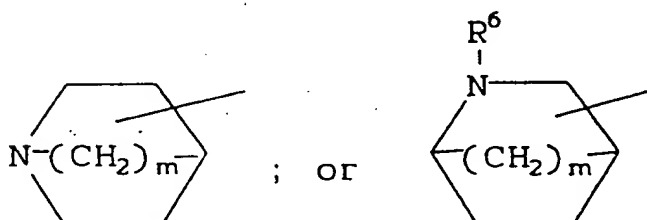
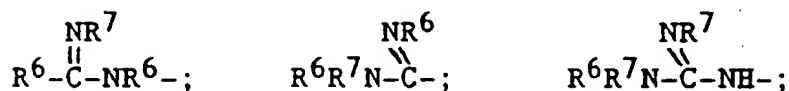
6. The use of a compound for the manufacture of a medicament for blocking fibrinogen from acting at its receptor site in a mammal, said compound being of the formula



# I

and the pharmaceutically acceptable salts thereof, wherein

**R<sup>1</sup>** is a four to eight member heterocyclic ring containing 1, 2, 3 or 4 hetero atoms wherein said heteroatoms are N, O or S and wherein said heterocyclic ring is optionally substituted at any atom by H, R<sup>6</sup> or R<sup>7</sup>;



NR<sup>6</sup>R<sup>7</sup> wherein R<sup>6</sup> and R<sup>7</sup> are independently hydrogen, C<sub>1-10</sub> alkoxy carbonyl or unsubstituted or substituted C<sub>1-10</sub> alkyl and cycloalkyl wherein said substituents are

C<sub>1-10</sub> alkoxy,  
C<sub>1-10</sub> alkoxyalkyl,  
C<sub>1-10</sub> alkoxyalkyloxy,  
C<sub>1-10</sub> alkoxycarbonyl,  
C<sub>1-10</sub> alkylcarbonyl,  
C<sub>0-6</sub> alkylaminocarbonyl,  
C<sub>1-10</sub> aralkylcarbonyl,  
C<sub>1-10</sub> alkylthiocarbonyl,  
C<sub>4-10</sub> aralkylthiocarbonyl,  
thiocarbonyl,  
C<sub>1-10</sub> alkoxythiocarbonyl,  
aryl,

5 to 6 membered saturated heterocyclic rings of 1, 2, 3 or 4 hetero atoms wherein said hetero atoms are taken from the group consisting of N, O and S,

C<sub>1-4</sub> alkanoylamino,  
 C<sub>1-6</sub> alkoxy carbonyl-C<sub>0-6</sub> alkylamino,  
 C<sub>1-10</sub> alkylsulfonylamino,  
 C<sub>4-10</sub> aralkylsulfonylamino,  
 C<sub>4-10</sub> aralkyl,  
 C<sub>1-10</sub> alkaryl,  
 C<sub>1-10</sub> alkylthio,  
 C<sub>4-10</sub> aralkylthio,  
 C<sub>1-10</sub> alkylsulfinyl,  
 C<sub>4-10</sub> aralkylsulfinyl,  
 C<sub>1-10</sub> alkylsulfonyl,  
 C<sub>4-10</sub> aralkylsulfonyl,  
 aminosulfonyl,  
 C<sub>1-10</sub> alkylaminosulfonyl,  
 C<sub>4-10</sub> aralkylsulfonylamino,

oxo,

thio,

unsubstituted or mono- or di-substituted 1-ethenyl, 2-ethenyl or 3-propenyl wherein said substituents are selected from the group consisting of hydrogen, C<sub>1-10</sub> alkyl and C<sub>7-10</sub>

aralkyl,

carboxy,

hydroxy,

amino,

C<sub>1-6</sub> alkylamino,

C<sub>1-6</sub> dialkylamino,

halogen, where halogen is defined as

Cl, F, Br, or I,

nitro, or

cyano,

and further wherein said N can additionally be substituted to form a quaternary ammonium ion wherein said substituent is as previously defined for R<sup>6</sup> and R<sup>7</sup>;

R<sup>2</sup> and R<sup>3</sup>

are independently

hydrogen,

aryl or

unsubstituted or substituted C<sub>0-10</sub> alkyl or cycloalkyl wherein said substituent is

C<sub>1-10</sub> alkoxyalkyl,

aryl,

a 4 to 8 membered heterocyclic ring containing 1, 2, 3 or 4 hetero atoms, wherein said hetero atoms are taken from the group consisting of N, O and S,

C<sub>4-10</sub> aralkyl,

C<sub>1-10</sub> alkaryl,

carboxy,

C<sub>1-10</sub> alkylcarbonyl,

C<sub>1-10</sub> alkylthiocarbonyl,

C<sub>4-10</sub> aralkylcarbonyl,

C<sub>4-10</sub> aralkylthiocarbonyl,

C<sub>1-6</sub> alkoxy carbonyl,

C<sub>4-10</sub> aralkoxy carbonyl,

C<sub>1-6</sub> alkoxy,

C<sub>4-10</sub> aralkoxy,

C<sub>1-6</sub> alkylamino,

C<sub>1-12</sub> dialkylamino,

C<sub>1-6</sub> alkanoylamino,

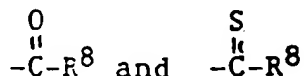
C<sub>4-12</sub> aralkanoylamino,

C<sub>4-10</sub> aralkylamino;

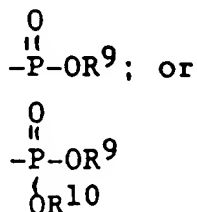
R<sup>4</sup> is  
hydrogen,  
aryl,  
C<sub>1-10</sub> alkyl or cycloalkyl  
5 C<sub>4-10</sub> aralkyl,  
arylcarbonyl, aminocarbonyl,  
C<sub>1-10</sub> alkylcarbonyl, C<sub>1-6</sub>alkylaminocarbonyl,  
C<sub>1-10</sub> alkylthiocarbonyl, C<sub>1-6</sub>dialkylaminocarbonyl,  
10 C<sub>1-10</sub> alkoxythiocarbonyl, arylC<sub>1-6</sub>alkylaminocarbonyl,  
C<sub>1-10</sub> alkoxy carbonyl,  
C<sub>4-10</sub> aralkylcarbonyl,  
C<sub>4-10</sub> aralkoxy carbonyl,  
C<sub>1-10</sub> carboxylalkyl and

15 further wherein any of the substituents for R<sup>4</sup> may be substituted by one or more substituents selected from the group as defined for R<sup>6</sup>, or an L- or D-amino acid joined by an amide linkage;

R<sup>5</sup> is  
a four to eight membered saturated or unsaturated heterocyclic ring containing 1, 2, 3 or 4 hetero atoms  
20 wherein said hetero atoms are N, O or S or,

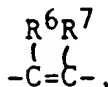


25 wherein R<sup>8</sup> is  
hydroxy,  
C<sub>1-10</sub> alkyloxy,  
30 C<sub>1-10</sub> alkaryloxy,  
C<sub>4-10</sub> aralkyloxy,  
C<sub>4-10</sub> aralkylcarbonyloxy,  
C<sub>1-10</sub> alkoxyalkyloxy,  
C<sub>1-10</sub> alkoxyalkylcarbonyloxy,  
35 C<sub>1-10</sub> alkoxy carbonyloxyalkyl,  
C<sub>1-10</sub> alkylcarbonyloxyalkyloxy,  
an L- or D-amino acid joined by an amide linkage, and wherein the carboxylic acid moiety of said amino acid is as the free acid or is esterified by C<sub>1-6</sub>alkyl.



40 wherein R<sup>9</sup> and R<sup>10</sup> are selected from the group consisting of  
50 hydrogen, C<sub>1-10</sub> alkyl and C<sub>4-10</sub> aralkyl;

X and Y are optional substituents that, when present, are NR<sup>6</sup>,  
O,  
S,  
55 SO,

SO<sub>2</sub>.

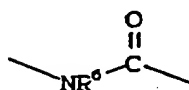
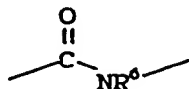
-C=C-

oxo,

aryl,

thiono,

unsubstituted or substituted C<sub>1-15</sub> alkyl or cycloalkyl wherein said substituents are independently R<sup>6</sup> and R<sup>7</sup>,



-NR<sup>6</sup>-SO<sub>2</sub>-, -SO<sub>2</sub>-NR<sup>6</sup>-, or a 4- to 8- membered heterocyclic ring containing 1, 2, 3, or 4 heteroatoms wherein said atoms are N, O, or S and wherein said ring is independently substituted at any atom with R<sup>6</sup>;

Z is an optional substituent that, when present, is independently chosen as defined by X and Y;

m is an integer of from zero to ten;

n is an integer of from zero to ten; and

p is an integer of from zero to three.

7. The use of a compound as defined in claim 6 for the manufacture of a medicament for prevention or treatment of thrombus and embolus formation.

8. The use of a compound as defined in claim 6 for the manufacture of a medicament for inhibiting aggregation of blood platelets.

9. The use of a compound as defined in claim 6 together with an anti-coagulant agent for the manufacture of a medicament for prevention or treatment of thrombus and embolus formation.

10. The use of a compound as defined in claim 6 together with an anti-coagulant agent for the manufacture of a medicament for inhibiting aggregation of blood platelets.

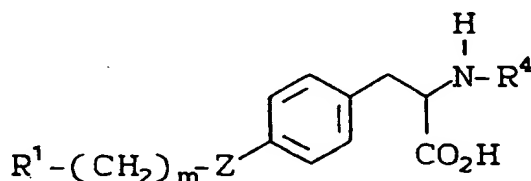
11. The use of a compound as defined in claim 6 together with a thrombolytic agent for the manufacture of a medicament for prevention or treatment of thrombus and embolus formation.

12. The use of a compound as defined in claim 6 together with a thrombolytic agent for the manufacture of a medicament for inhibiting aggregation of blood platelets.

13. The use of a compound as defined in claim 6 together with a platelet anti-aggregation agent for the manufacture of a medicament for prevention or treatment of thrombus and embolus formation.

14. The use of a compound as defined in claim 6 together with a platelet anti-aggregation agent for the manufacture of a medicament for inhibiting aggregation of blood platelets.

15. A pharmaceutical composition, comprising a compound as defined in claim 6, and a pharmaceutically acceptable carrier.
16. A pharmaceutical composition comprising a compound as defined in Claim 6, a pharmaceutically acceptable carrier and a compound taken from the group consisting of thrombolytic agents, platelet anti-aggregation agents and anti-coagulant agents.
17. The composition as claimed in Claim 15 or Claim 16, in which said pharmaceutically acceptable carrier consists of a sustained release pharmaceutical formulation.
18. The compounds defined in Claim 6 for use in inhibiting the binding of fibrinogen to blood platelets, inhibiting the aggregation of blood platelets, treating thrombus formation or embolus formation, or preventing thrombus or embolus formation in a mammal.
19. The compounds of Claim 5 for use in inhibiting the binding of fibrinogen to blood platelets, inhibiting the aggregation of blood platelets, treating of thrombus formation or embolus formation, or preventing thrombus or embolus formation in a mammal.
20. A compound as claimed in Claim 1 of formula



wherein

$\text{R}^1$  is a five or 6-membered heterocyclic ring wherein said heteroatom is N and wherein said heterocyclic ring is optionally substituted by hydrogen or  $\text{C}_{1-5}$  alkyl, or  $\text{NR}^6\text{R}^7$  wherein  $\text{R}^6$  and  $\text{R}^7$  are independently hydrogen,  $\text{C}_{1-10}$  alkyl or  $\text{C}_{4-10}$  arylalkyl;

$\text{R}^4$  is arylcarbonyl,  $\text{C}_{1-10}$  alkylcarbonyl,  $\text{C}_{1-10}$  alkoxycarbonyl,  $\text{C}_{4-10}$  aralkylcarbonyl,  $\text{C}_{4-10}$  aralkoxycarbonyl wherein  $\text{R}^4$  is unsubstituted or substituted with  $\text{R}^6$  as previously defined;

$\text{Z}$  is chosen from: O,  $-\text{NR}^6\text{CO}-$ ,  $-\text{CONR}^6-$ , or  $\text{CH}_2$ ; and

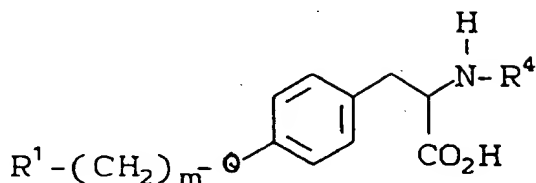
$m$  is an integer of from one to six;

with the exception of:

N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine;  
 N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine;  
 N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminoethyl)-L-tyrosine; and  
 $\alpha$ -benzoylamino-4-(2-diethylaminoethoxy)benzenepropanoic acid.

Claims for the following Contracting States : ES, GR

1. A process for the preparation of a compound of formula



or a pharmaceutically acceptable salt thereof wherein

$\text{R}^1$  is a five or 6-membered heterocyclic ring wherein said heteroatom is N and wherein said heterocyclic ring is optionally substituted by hydrogen or  $\text{C}_{1-5}$  alkyl, or  $\text{NR}^6\text{R}^7$  wherein  $\text{R}^6$  and  $\text{R}^7$  are independently hydrogen,  $\text{C}_{1-10}$  alkyl or  $\text{C}_{4-10}$  arylalkyl;

$\text{R}^4$  is arylcarbonyl,  $\text{C}_{1-10}$  alkylcarbonyl,  $\text{C}_{1-10}$  alkoxycarbonyl,  $\text{C}_{4-10}$  aralkylcarbonyl,  $\text{C}_{4-10}$  aralkoxycarbonyl wherein  $\text{R}^4$  is unsubstituted or substituted with  $\text{R}^6$  as previously defined; and

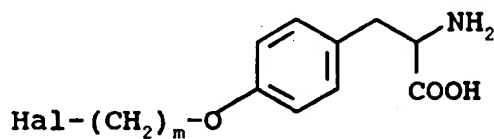
$m$  is an integer of from one to six;

with the exception of:

N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine;  
N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine;  
N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminoethyl)-L-tyrosine; and  
 $\alpha$ -benzoylamino-4-(2-diethylaminoethoxy)benzenepropanoic acid;

which comprises:

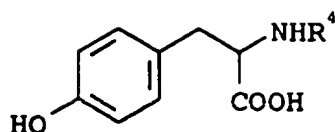
reacting a compound of formula



or a protected derivatives thereof, where Hal is a halogen atom, with a compound of formula  $\text{R}^1\text{-H}$ ; followed, where necessary, by the removal of any protecting group if present.

2. A process as claimed in claim 1 which comprises:

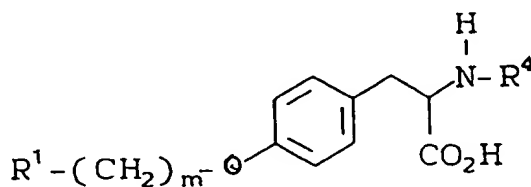
1) reacting a compound of formula



or a protected derivative thereof, with a compound of formula  $\text{Hal}-(\text{CH}_2)_m\text{-Hal}$ , where Hal is a halogen atom, in the presence of a base; and

2) reacting the product of step (1) with a compound of formula  $\text{R}^1\text{-H}$ ; followed, where necessary, by the removal of any protecting group if present.

3. A process for the preparation of a compound of formula



or a pharmaceutically acceptable salt thereof wherein

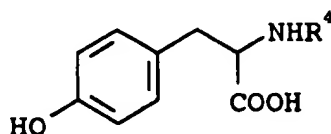
$\text{R}^1$  is a five or 6-membered heterocyclic ring wherein said heteroatom is N and wherein said heterocyclic ring is optionally substituted by hydrogen or  $\text{C}_{1-5}$  alkyl, or  $\text{NR}^6\text{R}^7$  wherein  $\text{R}^6$  and  $\text{R}^7$  are independently hydrogen,  $\text{C}_{1-10}$  alkyl or  $\text{C}_{4-10}$  arylalkyl;

$\text{R}^4$  is arylcarbonyl,  $\text{C}_{1-10}$  alkylcarbonyl,  $\text{C}_{1-10}$  alkoxy carbonyl,  $\text{C}_{4-10}$  aralkylcarbonyl,  $\text{C}_{4-10}$  aralkoxy carbonyl wherein  $\text{R}^4$  is unsubstituted or substituted with  $\text{R}^6$  as previously defined; and

$m$  is an integer of from one to six;

with the exception of:

N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine;  
N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine;  
N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminoethyl)-L-tyrosine; and  
 $\alpha$ -benzoylamino-4-(2-diethylaminoethoxy)benzenepropanoic acid;  
which comprises reacting a compound of formula

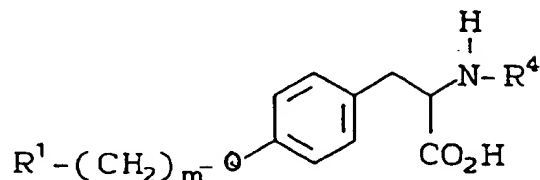


or a protected derivative thereof, with a compound of formula  $\text{R}^1-(\text{CH}_2)_m\text{-Hal}$  or a protected derivative thereof, where



Hal is a halogen atom, in the presence of a base;  
followed, where necessary, by the removal of any protecting group if present.

4. A process for the preparation of a compound of formula



or a pharmaceutically acceptable salt thereof  
wherein

$\text{R}^1$  is  
a five or 6-membered heterocyclic ring wherein said heteroatom is N and wherein said heterocyclic ring  
is optionally substituted by hydrogen or  $\text{C}_{1-5}$  alkyl, or  
 $\text{NR}^6\text{R}^7$  wherein  $\text{R}^6$  and  $\text{R}^7$  are independently hydrogen,  $\text{C}_{1-10}$  alkyl or  $\text{C}_{4-10}$  arylalkyl;

$\text{R}^4$  is  
arylcarbonyl,  
 $\text{C}_{1-10}$  alkylcarbonyl,  
 $\text{C}_{1-10}$  alkoxy carbonyl,  
 $\text{C}_{4-10}$  aralkylcarbonyl,  
 $\text{C}_{4-10}$  aralkoxy carbonyl wherein  $\text{R}^4$  is unsubstituted or substituted with  $\text{R}^6$  as previously defined; and

$m$  is an integer of from one to six;

with the exception of:

N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine;

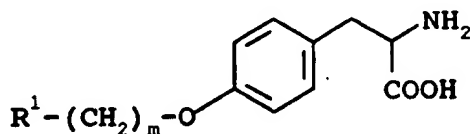
N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine;

N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminoethyl)-L-tyrosine; and

$\alpha$ -benzoylamino-4-(2-diethylaminoethoxy)benzenepropanoic acid;

which comprises:

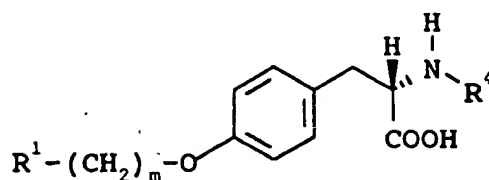
reacting a compound of formula



or a protected derivative thereof, with a compound of formula  $\text{R}'\text{CO}_2\text{H}$  or an activated acyl halide derivative thereof  
(where  $\text{R}'$  is aryl,  $\text{C}_{1-10}$ alkyl,  $\text{C}_{1-10}$ alkoxy,  $\text{C}_{4-10}$ aralkyl or  $\text{C}_{4-10}$ aralkoxy, each of which may be unsubstituted or  
substituted with  $\text{R}^6$  as previously defined);

followed, where necessary, by the removal of any protecting group if present.

5. A process as claimed in any one of claims 1 to 4 for the preparation of a compound of formula



wherein R¹, R⁴ and m are as defined in claim 1;  
or a pharmaceutically acceptable salt thereof.

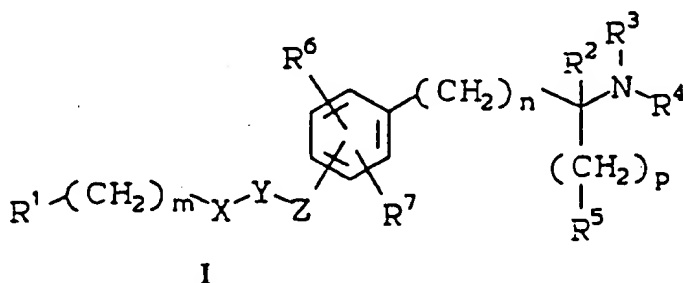
6. A process as claimed in any one of claims 1 to 4 for the preparation of a compound selected from the group consisting of:

2-S-(N-Benzyloxycarbonylamino)-3-[4-(3-N-pyrrolidinylpropyloxy)phenyl]propionic acid ;  
2-S-(N-Benzyloxycarbonylamino)-3-[4-(4-piperazinyl)butyloxyphenyl]propionic acid;  
2-S-(N-Benzyloxycarbonyl)-3-[4-(4-methylpiperazin-1-yl)propyloxyphenyl]propanoic acid;  
2-S-(N-Benzyloxycarbonylamino)-3-[4-(4-piperazin-1-yl)pentyloxyphenyl]propionic acid;  
2-S-(N-Benzyloxycarbonylamino)-3-[4-(4-piperidinyl)butyloxyphenyl]propionic acid;  
2-S-(N-Benzyloxycarbonylamino)-3-[4-(4-piperidinyl)but-2-enyloxyphenyl]propionic acid;  
2-S-(Pentanoylamino)-3-[4-(4-piperidin-4-ylbutyloxy)phenyl]propionic acid hydrochloride;  
2-S-(Hexanoylamino)-3-[4-(4-piperidin-4-ylbutyloxy)phenyl]propionic acid;  
or a pharmaceutically acceptable salt thereof.

#### Patentansprüche

Patentansprüche für folgende Vertragsstaaten : AT, BE, CH, DE, DK, FR, GB, IT, LI, LU, NL, SE

1. Eine Verbindung der Formel

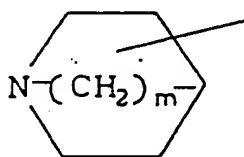
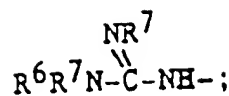


und deren pharmazeutisch verträgliche Salze, wobei

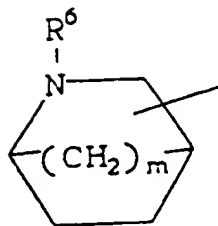
R¹

ein vier- bis achtegliedriger heterocyclischer Ring, der 1, 2, 3 oder 4 Heteroatome enthält, wobei die Heteroatome N, O oder S sind und wobei der heterocyclische Ring gegebenenfalls an jedem Atom

mit H, R<sup>6</sup> oder R<sup>7</sup> substituiert ist;



oder



NR<sup>6</sup>R<sup>7</sup> ist, wobei R<sup>6</sup> und R<sup>7</sup> unabhängig voneinander Wasserstoff,

C<sub>1-10</sub>-Alkoxy-carbonyl oder

unsubstituiertes oder substituiertes C<sub>1-10</sub>-Alkyl und Cycloalkyl sind, wobei die Substituenten

C<sub>1-10</sub>-Alkoxy,

C<sub>1-10</sub>-Alkoxyalkyl,

C<sub>1-10</sub>-Alkoxyalkyloxy,

C<sub>1-10</sub>-Alkoxy-carbonyl,

C<sub>1-10</sub>-Alkyl-carbonyl,

C<sub>0-6</sub>-Alkylaminocarbonyl,

C<sub>1-10</sub>-Aralkyl-carbonyl,

C<sub>1-10</sub>-Alkylthiocarbonyl,

C<sub>4-10</sub>-Aralkylthiocarbonyl,

Thiocarbonyl,

C<sub>1-10</sub>-Alkoxythiocarbonyl,

5-bis 6-gliedrige, gesättigte heterocyclische Ringe mit 1, 2, 3 oder 4 Heteroatomen, wobei die Heteroatome aus der Gruppe stammen, die aus N, O und S besteht,

C<sub>1-4</sub>-Alkanoylamino,

C<sub>1-6</sub>-Alkoxy-carbonyl-C<sub>0-6</sub>-alkylamino,

C<sub>1-10</sub>-Alkylsulfonylamino,

C<sub>4-10</sub>-Aralkylsulfonylamino,

C<sub>4-10</sub>-Aralkyl,

C<sub>1-10</sub>-Alkaryl,

C<sub>1-10</sub>-Alkylthio,

C<sub>4-10</sub>-Aralkylthio,

C<sub>1-10</sub>-Alkylsulfinyl,

C<sub>4-10</sub>-Aralkylsulfinyl,

C<sub>1-10</sub>-Alkylsulfonyl,

C<sub>4-10</sub>-Aralkylsulfonyl,

Aminosulfonyl,

C<sub>1-10</sub>-Alkylaminosulfonyl,

C<sub>4-10</sub>-Aralkylsulfonylamino,

Oxo,

Thio,

unsubstituiertes oder mono- oder disubstituiertes 1-Ethenyl, 2-Ethenyl oder 3-Propenyl, wobei die Substituenten aus der Gruppe ausgewählt sind, die aus Wasserstoff, C<sub>1-10</sub>-Alkyl und C<sub>7-10</sub>-Aralkyl besteht,

Carboxy,

Hydroxy,

Amino,

C<sub>1-6</sub>-Alkylamino,

C<sub>1-6</sub>-Dialkylamino

Halogen, wobei Halogen als Cl, F, Br oder I definiert ist,

Nitro oder

Cyano sind  
und weiterhin, wobei das N-Atom zusätzlich unter Bildung eines quartären Ammoniumions substituiert sein kann, wobei der Substituent wie vorstehend für R<sup>6</sup> und R<sup>7</sup> definiert ist;

R<sup>2</sup> und R<sup>3</sup> unabhängig voneinander

Wasserstoff,

Aryl oder

unsubstituiertes oder substituiertes C<sub>0-10</sub>-Alkyl oder Cycloalkyl sind, wobei der Substituent

C<sub>1-10</sub>-Alkoxyalkyl,

Aryl,

ein 4- bis 8-gliedriger heterocyclischer Ring, der 1, 2, 3 oder 4 Heteroatome enthält, wobei die Heteroatome aus der Gruppe stammen, die aus N, O und S besteht,

C<sub>4-10</sub>-Aralkyl,

C<sub>1-10</sub>-Alkaryl,

Carboxy,

C<sub>1-10</sub>-Alkylcarbonyl,

C<sub>1-10</sub>-Alkylthiocarbonyl,

C<sub>4-10</sub>-Aralkylcarbonyl,

C<sub>4-10</sub>-Aralkylthiocarbonyl,

C<sub>1-6</sub>-Alkoxycarbonyl,

C<sub>4-10</sub>-Aralkoxycarbonyl,

C<sub>1-6</sub>-Alkoxy,

C<sub>4-10</sub>-Aralkoxy,

C<sub>1-6</sub>-Alkylamino,

C<sub>1-12</sub>-Dialkylamino,

C<sub>1-6</sub>-Alkanoylamino,

C<sub>4-12</sub>-Aralkanoylamino,

C<sub>4-10</sub>-Aralkylamino

ist;

R<sup>4</sup>

Wasserstoff,

Aryl,

C<sub>1-10</sub>-Alkyl oder Cycloalkyl

C<sub>4-10</sub>-Aralkyl,

Arylcarbonyl, Aminocarbonyl,

C<sub>1-10</sub>-Alkylcarbonyl, C<sub>1-6</sub>-Alkylaminocarbonyl,

C<sub>1-10</sub>-Alkylthiocarbonyl, C<sub>1-6</sub>-Dialkylaminocarbonyl,

C<sub>1-10</sub>-Alkoxythiocarbonyl, Aryl-C<sub>1-6</sub>-alkylaminocarbonyl,

C<sub>1-10</sub>-Alkoxycarbonyl,

C<sub>4-10</sub>-Aralkylcarbonyl,

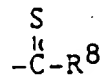
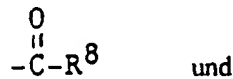
C<sub>4-10</sub>-Aralkoxycarbonyl,

C<sub>1-10</sub>-Carboxylalkyl ist und

weiterhin, wobei jeder der Substituenten für R<sup>4</sup> durch einen oder mehrere Substituenten substituiert sein kann, die ausgewählt sind aus der Gruppe, wie sie für R<sup>6</sup> definiert ist, oder durch eine L- oder D-Aminosäure, die durch eine Amidbindung angefügt wird;

R<sup>5</sup>

ein vier- bis achtegliedriger gesättigter oder ungesättigter heterocyclischer Ring, der 1, 2, 3 oder 4 Heteroatome enthält, wobei diese Heteroatome N, O oder S sind, oder



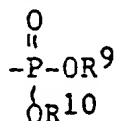
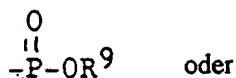
wobei R<sup>8</sup>

Hydroxy,

C<sub>1-10</sub>-Alkyloxy,

C<sub>1-10</sub>-Alkaryloxy,C<sub>4-10</sub>-Aralkyloxy,C<sub>4-10</sub>-Aralkylcarbonyloxy,C<sub>1-10</sub>-Alkoxyalkyloxy,C<sub>1-10</sub>-Alkoxyalkylcarbonyloxy,C<sub>1-10</sub>-Alkoxycarbonyloxyalkyl,C<sub>1-10</sub>-Alkylcarbonyloxyalkyloxy,

eine durch eine Amidbindung angefügte L- oder D-Aminosäure ist, und wobei der Carbonsäureanteil dieser Aminosäure als die freie Säure vorliegt oder mit C<sub>1-6</sub>-Alkyl verestert ist,



ist, wobei R<sup>9</sup> und R<sup>10</sup> ausgewählt sind aus der Gruppe, die aus Wasserstoff, C<sub>1-10</sub>-Alkyl und C<sub>4-10</sub>-Aralkyl besteht;

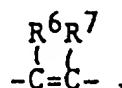
X und Y wahlweise Substituenten sind, die, wenn vorhanden,

NR<sup>6</sup>,

O,

S,

SO,

SO<sub>2</sub>,

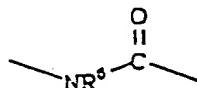
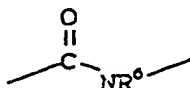
-CH=CH-,

Oxo,

Aryl,

Thiono,

unsubstituiertes oder substituiertes C<sub>1-15</sub>-Alkyl oder Cycloalkyl, wobei die Substituenten unabhängig voneinander R<sup>6</sup> und R<sup>7</sup> sind,

-NR<sup>6</sup>-SO<sub>2</sub>-, -SO<sub>2</sub>-NR<sup>6</sup>- oder

ein 4- bis 8-gliedriger heterocyclischer Ring sind, der 1, 2, 3 oder 4 Heteroatome enthält, wobei diese Atome N, O oder S sind und wobei dieser Ring an jedem beliebigen Atom unabhängig voneinander mit R<sup>6</sup> substituiert ist;

Z ein wahlweiser Substituent ist, der, wenn vorhanden, unabhängig aus der Gruppe ausgewählt ist, wie sie für X und Y definiert ist;

m eine ganze Zahl von null bis zehn ist;

n eine ganze Zahl von null bis zehn ist; und

p eine ganze Zahl von null bis drei ist;

mit der Ausnahme von:

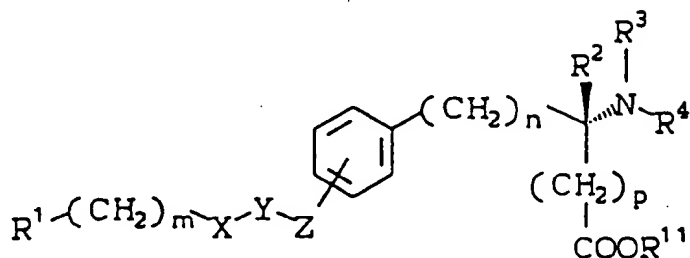
N-tert.-Butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosin;

N-tert.-Butoxycarbonyl-O-(3-aminopropyl)-L-tyrosin;

N-tert.-Butoxycarbonyl-O-(3-tert.-butoxycarbonylaminoethyl)-L-tyrosin und

$\alpha$ -Benzoylamino-4-(2-diethylaminoethoxy)benzylpropionsäure.

## 2. Eine Verbindung der Strukturformel



und deren pharmazeutisch verträgliche Salze, wobei

R¹ ein vier- bis achtegliedriger heterocyclischer Ring, der 1, 2, 3 oder 4 Heteroatome enthält, wobei diese Heteroatome N, O oder S sind und wobei der heterocyclische Ring gegebenenfalls mit Wasserstoff, C₁-₁₀-Alkyl substituiert ist;

oder

NR⁶R⁷, wobei R⁶ und R⁷ unabhängig voneinander

Wasserstoff,

C₁-₁₀-Alkoxycarbonyl oder

unsubstituiertes oder substituiertes C₁-₁₀-Alkyl sind, wobei dieser Substituent

C₁-₁₀-Alkoxy,

C₁-₁₀-Alkoxycarbonyl,

Aryl,

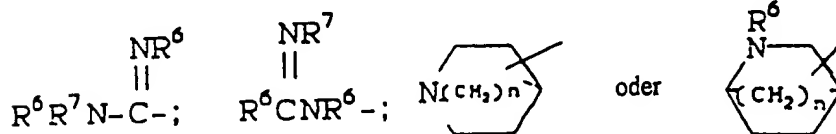
C₄-₁₀-Aralkyl,

C₁-₁₀-Alkaryl,

Carboxy,

Hydroxy oder

Amino ist,



ist und weiterhin, wobei das N-Atom zusätzlich unter Bildung eines quartären Ammoniumions substituiert sein kann;

R² und R³ unabhängig voneinander

Wasserstoff oder

C₁-₁₀-Alkyl oder

C₄-₁₀-Aralkyl sind;

R⁴

Wasserstoff,

C₁-₁₀-Alkyl,

C₄-₁₀-Aralkyl,

Arylcarbonyl,

Aralkylcarbonyl,

C<sub>1-10</sub>-Alkylcarbonyl,  
 C<sub>1-10</sub>-Alkoxycarbonyl,  
 C<sub>4-10</sub>-Aralkylcarbonyl,  
 C<sub>4-10</sub>-Aralkoxycarbonyl

ist und weiterhin, wobei jeder der Substituenten für R<sup>4</sup> durch einen oder mehrere Substituenten aus der Gruppe substituiert sein kann, wie sie als R<sup>6</sup> in Anspruch 1 definiert ist;

R<sup>11</sup>

Wasserstoff oder

C<sub>1-10</sub>-Alkyl ist;

X und Y

unabhängig voneinander

O,

S, SO

SO<sub>2</sub>,

Aryl,

-CH=CH-,

Oxo,



-NR<sup>6</sup>SO<sub>2</sub>- -SO<sub>2</sub>NR<sup>6</sup>- ,

unsubstituiertes oder substituiertes, gerades oder verzweigtes C<sub>1-15</sub>-Alkyl sind, das entweder substituiert oder unsubstituiert ist mit

Carboxy,

Hydroxy,

C<sub>1-10</sub>-Alkoxy oder

einem 4- bis 6-gliedrigen heterocyclischen Ring mit 1, 2 oder 3 Heteroatomen, die ausgewählt

sind aus N, O oder S,

Z

ein wahlweiser Substituent ist, der, wenn vorhanden,

O, SO<sub>2</sub>, -NR<sup>6</sup>CO-; -CONR<sup>6</sup>;



gerades oder verzweigtes C<sub>1-10</sub>-Alkyl ist;

m

eine ganze Zahl von null bis sechs ist;

n

eine ganze Zahl von null bis sechs ist; und

p

eine ganze Zahl von null bis drei ist;

mit der Ausnahme von:

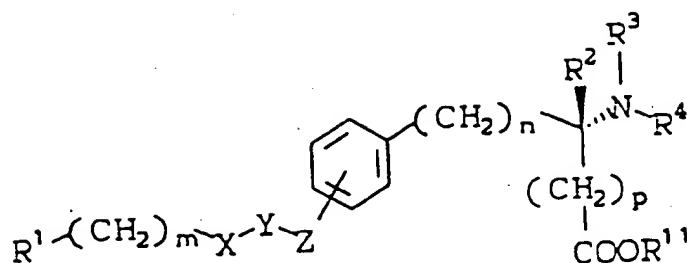
N-tert.-Butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosin;

N-tert.-Butoxycarbonyl-O-(3-aminopropyl)-L-tyrosin;

N-tert.-Butoxycarbonyl-O-(3-tert.-butoxycarbonylaminopropyl)-L-tyrosin und

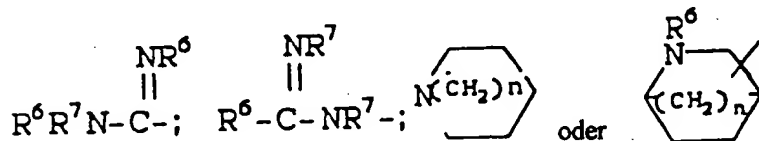
α-Benzoylamino-4-(2-diethylaminoethoxy)benzolpropionsäure.

## 3. Eine Verbindung der Strukturformel



und deren pharmazeutisch verträgliche Salze, wobei

R¹ ein fünf- bis sechsgliedriger heterocyclischer Ring, der 1 oder 2 Heteroatome enthält, wobei die Heteroatome N sind und wobei der heterocyclische Ring gegebenenfalls mit C₁-₅-Alkyl substituiert ist; oder  
 NR⁶R⁷, wobei R⁶ und R⁷ unabhängig voneinander Wasserstoff, unsubstituiertes oder substituiertes C₁-₁₀-Alkyl sind, wobei der Substituent C₁-₁₀-Alkoxy-carbonyl, Aryl, C₁-₁₀-Aralkyl ist,



ist und weiterhin, wobei das N-Atom zusätzlich unter Bildung eines quartären Ammoniumions substituiert sein kann;

R² und R³  
R⁴

Wasserstoff sind;

Arylcarbonyl,  
 C₁-₁₀-Alkylcarbonyl,  
 Aralkylcarbonyl,  
 C₁-₁₀-Alkoxy-carbonyl,  
 C₄-₁₀-Aralkylcarbonyl,  
 C₄-₁₀-Aralkoxy-carbonyl ist

und weiterhin, wobei die Substituenten für R⁴ durch einen oder mehrere Substituenten aus der Gruppe substituiert sein können, wie sie als R⁶ in Anspruch 1 definiert ist;

R¹¹

Wasserstoff oder  
 C₁-₁₀-Alkyl ist;

X und Y

unabhängig voneinander  
 O, SO₂, Aryl; NR⁶CO-; -CONR⁶-  
 -CH=CH-,

unsubstituiertes oder substituiertes, gerades oder verzweigtes C₁-₁₅-Alkyl, wobei der Substituent Hydroxy ist, oder

ein 4- bis 6-gliedriger heterocyclischer Ring sind, der 1 oder 2 Heteroatome enthält, ausgewählt aus N, O oder S;

Z

ein wahlweiser Substituent ist, der, wenn vorhanden, O oder

gerades oder verzweigtes C₁-₁₀-Alkyl ist;

m

eine ganze Zahl von null bis sechs ist;



n eine ganze Zahl von null bis eins ist; und

p eine ganze Zahl von null bis eins ist;

mit der Ausnahme von:

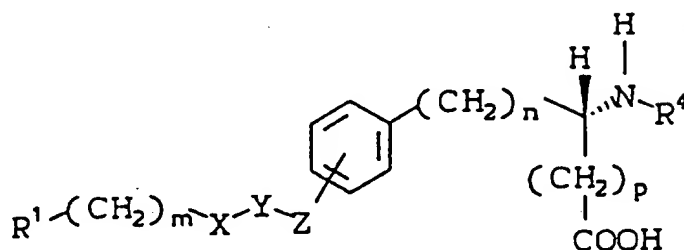
N-tert.-Butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosin;

N-tert.-Butoxycarbonyl-O-(3-aminopropyl)-L-tyrosin;

N-tert.-Butoxycarbonyl-O-(3-tert.-butoxycarbonylaminoethyl)-L-tyrosin und

$\alpha$ -Benzoylamino-4-(2-diethylaminoethoxy)benzylpropionsäure.

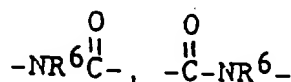
#### 4. Eine Verbindung der Strukturformel



und deren pharmazeutisch verträgliche Salze, wobei

R¹ ein sechsgliedriger gesättigter heterocyclischer Ring, der 1 oder 2 Heteroatome enthält, wobei die Heteroatome N sind und wobei der heterocyclische Ring gegebenenfalls mit C<sub>1-5</sub>-Alkyl substituiert ist; oder NR<sup>6</sup>R<sup>7</sup> ist, wobei R<sup>6</sup> und R<sup>7</sup> unabhängig voneinander Wasserstoff oder C<sub>1-10</sub>-Alkyl sind;

R⁴ Arylcarbonyl, C<sub>1-10</sub>-Alkylcarbonyl, C<sub>4-10</sub>-Aralkylcarbonyl, C<sub>1-10</sub>-Alkoxyarbonyl, C<sub>4-10</sub>-Aralkylcarbonyl oder C<sub>4-10</sub>-Aralkoxyarbonyl ist und weiterhin, wobei jeder der Substituenten für R⁴ durch einen oder mehrere Substituenten substituiert sein kann, die ausgewählt sind aus der Gruppe, wie sie als R<sup>6</sup> in Anspruch 1 definiert ist, X und Y unabhängig voneinander O, SO<sub>2</sub>, Aryl,



Z -CH=CH- oder gerades oder verzweigtes C<sub>1-10</sub>-Alkyl sind; ein wählweiser Substituent ist, der, wenn vorhanden, O oder gerades oder verzweigtes C<sub>1-5</sub>-Alkyl ist; m eine ganze Zahl von null bis sechs ist; n eins ist; und p null ist;

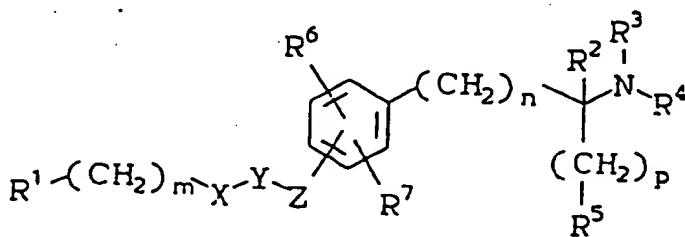
mit der Ausnahme von:

N-tert.-Butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosin;

N-tert.-Butoxycarbonyl-O-(3-aminopropyl)-L-tyrosin;

N-tert.-Butoxycarbonyl-O-(3-tert.-butoxycarbonylaminopropyl)-L-tyrosin und  
 $\alpha$ -Benzoylamin-4-(2-diethylaminoethoxy)benzylpropionsäure.

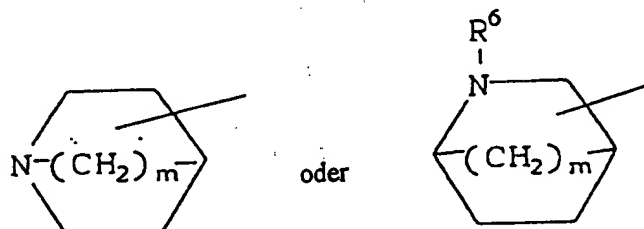
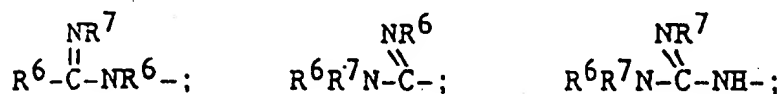
5. Eine Verbindung, wie in Anspruch 1 beansprucht, ausgewählt aus der Gruppe, bestehend aus:
- 2-S-(6-N-Benzylloxycarbonylamino)-3-[4-(3-chloropropoxy)phenyl]propionsäure;
  - 2-S-(N-Benzylloxycarbonylamino)-3-[4-(N, N, 2, 2-tetramethyl-1,3-propandiamino)propyloxyphenyl]propionsäure;
  - 2-S-(N-Benzylloxycarbonylamino)-3-[4-(3-N-pyrrolidinylpropyloxy)phenyl]propionsäure;
  - 2-S-(N-Benzylloxycarbonylamino)-4-(3-N-methy-N-benzylaminopropoxy)phenyl]propionsäure;
  - 2-S-(N-Benzylloxycarbonylamino)-3-[4-(4-piperazinyl)butyloxyphenyl]propionsäure;
  - 2-S-(N-Benzylloxycarbonylamino)-3-[4-(1, 1, 4, 4-tetramethylbutylamino)propyloxyphenyl]propionsäure;
  - 2-S-(N-Benzylloxycarbonylamino)-3-[4-(4-methylpiperazin-1-yl)propyloxyphenyl]propionsäure;
  - 2-S-(N-Benzylloxycarbonylamino)-3-[4-(5-bromopentyloxy)phenyl]propionsäure;
  - 2-S-(N-Benzylloxycarbonylamino)-3-[4-(4-piperazin-1-yl)pentyloxyphenyl]propionsäure;
  - 2-S-(N-Benzylloxycarbonylamino)-3-[4-(6-aminohexyloxyphenyl)]propionsäurehydrochlorid;
  - 2-S-(N-Benzylloxycarbonylamino)-3-[4-(7-aminoheptyloxy)-phenyl]propionsäurehydrochlorid;
  - 2-S-(N-Benzylloxycarbonylamino)-3-[4-(8-aminooctyloxy)-phenyl]propionsäure;
  - 2-S-(N-Benzylloxycarbonylamino)-3-[4-(5-aminopentyloxy)-phenyl]propionsäurehydrochlorid;
  - 2-S-(N-Benzylloxycarbonylamino)-3-[4-(4-piperidinylbutyloxy)phenyl]propionsäure;
  - 2-S-Phenylcarbonylamino-3-[4-(6-aminohexyloxy)phenyl]propionsäurehydrochlorid;
  - 2-S-Phenethylcarbonylamino-3-[4-(6-aminohexyloxy)phenyl]propionsäurehydrochlorid;
  - 2-S-(Phenylacetylamo)-3-[4-(6-aminohexyloxy)phenyl]propionsäure;
  - 2-S-(2-Carboxy-3-phenylpropionylamino)-3-[4-(6-aminohexyloxy)phenyl]propionsäure;
  - 2-S-(Hexanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionsäurehydrochlorid;
  - 2-S-(Naphtanoylamino)-3-[4-(6-aminohexyloxyphenyl]propionsäure;
  - 2-S-(Butanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionsäure;
  - 2-S-(Heptanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionsäurehydrochlorid;
  - 2-(S)-(5-Phenylpentanoylamino)-3-[4-(6-t-butyloxycarbonylaminohexyloxy)phenyl]propionsäure;
  - 2-S-(5-Phenylpentanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionsäurehydrochlorid;
  - 2-S-(3-Carboxypropanoyl)amino-3-[4-(6-aminohexyloxy)phenyl]propionsäurehydrochlorid;
  - 2-S-(Acetylamo)-3-[4-(6-aminohexyloxy)phenyl]propionsäurehydrochlorid;
  - 2-S-(N-Benzylloxycarbonylamino)-3-[4-(4-piperidinyl)-but-2-enyloxyphenyl]propionsäure;
  - 2-S-(N-t-Butyloxycarbonylamino)-3-[4-(4-hydroxybut-1-ynyl)phenyl]propionsäure;
  - 2-S-(N-t-Butyloxycarbonylamino)-3-[4-(4-hydroxybutyl)phenyl]propionsäure;
  - 2-S-(N-t-Butyloxycarbonylamino)-3-[4-(4-t-butylaminobutyl)phenyl]propionsäure;
  - 2-S-(Pentanoylamino)-3-[4-(4-piperidin-4-ylbutyloxy)phenyl]propionsäurehydrochlorid;
  - 2-S-(Hexanoylamino)-3-[4-(4-piperidin-4-ylbutyloxy)phenyl]propionsäure;
  - 2-S-(5-Aminopentanoyl)amino-3-[4-(6-aminohexyloxy)phenyl]propionsäuredihydrochlorid;
  - Methyl-2-S-(4-carbomethoxybutanoyl)amino-3-[4-(N-t-butyloxycarbonylaminohexyloxy)phenyl]propionat; und
  - 2-S-(4-Carboxybutanoylamino)-3-[4-(6-aminohexyloxy)phenyl]propionsäure.
6. Die Verwendung einer Verbindung für die Herstellung eines Medikamentes zur Blockierung der Wirkung von Fibrinogen an seiner Rezeptorstelle in einem Säuger, wobei diese Verbindung die Formel



I

besitzt, und deren pharmazeutisch verträgliche Salze,  
wobei

R<sup>1</sup> ein vier- bis achtegliedriger heterocyclischer Ring, der 1, 2, 3 oder 4 Heteroatome enthält, wobei die Heteroatome N, O oder S sind und wobei der heterocyclische Ring gegebenenfalls an jedem Atom mit H, R<sup>6</sup> oder R<sup>7</sup> substituiert ist;



NR<sup>6</sup>R<sup>7</sup> ist, wobei R<sup>6</sup> und R<sup>7</sup> unabhängig voneinander Wasserstoff,

C<sub>1-10</sub>-Alkoxy-carbonyl oder unsubstituiertes oder substituiertes C<sub>1-10</sub>-Alkyl und Cycloalkyl sind, wobei die Substituenten

C<sub>1-10</sub>-Alkoxy,  
C<sub>1-10</sub>-Alkoxyalkyl,  
C<sub>1-10</sub>-Alkoxyalkyloxy,  
C<sub>1-10</sub>-Alkoxy-carbonyl,  
C<sub>1-10</sub>-Alkyl-carbonyl,  
C<sub>0-6</sub>-Alkylaminocarbonyl,  
C<sub>1-10</sub>-Aralkyl-carbonyl,  
C<sub>1-10</sub>-Alkylthiocarbonyl,  
C<sub>4-10</sub>-Aralkylthiocarbonyl,  
Thiocarbonyl,  
C<sub>1-10</sub>-Alkoxythiocarbonyl,  
Aryl,

5- bis 6-gliedrige, gesättigte heterocyclische Ringe, die 1, 2, 3 oder 4 Heteroatome enthalten, wobei die Heteroatome aus der Gruppe stammen, die aus N, O und S besteht,

C<sub>1-4</sub>-Alkanoylamino,  
C<sub>1-6</sub>-Alkoxy-carbonyl-C<sub>0-6</sub>-alkylamino,  
C<sub>1-10</sub>-Alkylsulfonylamino,  
C<sub>4-10</sub>-Aralkylsulfonylamino,  
C<sub>4-10</sub>-Aralkyl,  
C<sub>1-10</sub>-Alkaryl,  
C<sub>1-10</sub>-Alkylthio,  
C<sub>4-10</sub>-Aralkylthio,  
C<sub>1-10</sub>-Alkylsulfinyl,  
C<sub>4-10</sub>-Aralkylsulfinyl,  
C<sub>1-10</sub>-Alkylsulfonyl,  
C<sub>4-10</sub>-Aralkylsulfonyl,  
Aminosulfonyl,  
C<sub>1-10</sub>-Alkylaminosulfonyl,  
C<sub>4-10</sub>-Aralkylsulfonylamino,

Oxo,  
Thio,

unsubstituiertes oder mono- oder disubstituiertes 1-Ethenyl, 2-Ethenyl oder 3-Propenyl, wobei die Substituenten aus der Gruppe ausgewählt sind, die aus Wasserstoff, C<sub>1-10</sub>-Alkyl und C<sub>7-10</sub>-Aralkyl besteht,

Carboxy,  
Hydroxy,  
Amino,  
C<sub>1-6</sub>-Alkylamino,  
C<sub>1-6</sub>-Dialkylamino

Halogen, wobei Halogen als Cl, F, Br oder I definiert ist,

Nitro oder

Cyano sind

und weiterhin, wobei das N-Atom zusätzlich unter Bildung eines quartären Ammoniumions substituiert sein kann, wobei der Substituent wie vorstehend für R<sup>6</sup> und R<sup>7</sup> definiert ist;

R<sup>2</sup> und R<sup>3</sup> unabhängig voneinander

Wasserstoff,

Aryl oder

unsubstituiertes oder substituiertes C<sub>0-10</sub>-Alkyl oder Cycloalkyl sind, wobei der Substituent

C<sub>1-10</sub>-Alkoxyalkyl,

Aryl,

ein 4- bis 8-gliedriger heterocyclischer Ring, der 1, 2, 3 oder 4 Heteroatome enthält, wobei die Heteroatome aus der Gruppe stammen, die aus N, O und S besteht,

C<sub>4-10</sub>-Aralkyl,

C<sub>1-10</sub>-Alkaryl,

Carboxy,

C<sub>1-10</sub>-Alkylcarbonyl,

C<sub>1-10</sub>-Alkylthiocarbonyl,

C<sub>4-10</sub>-Aralkylcarbonyl,

C<sub>4-10</sub>-Aralkylthiocarbonyl,

C<sub>1-6</sub>-Alkoxycarbonyl,

C<sub>4-10</sub>-Aralkoxycarbonyl,

C<sub>1-6</sub>-Alkoxy,

C<sub>4-10</sub>-Aralkoxy,

C<sub>1-6</sub>-Alkylamino,

C<sub>1-12</sub>-Dialkylamino,

C<sub>1-6</sub>-Alkanoylamino,

C<sub>4-12</sub>-Aralkanoylamino,

C<sub>4-10</sub>-Aralkylamino ist;

R<sup>4</sup>

Wasserstoff,

Aryl,

C<sub>1-10</sub>-Alkyl oder Cycloalkyl,

C<sub>4-10</sub>-Aralkyl,

Arylcarbonyl, Aminocarbonyl,

C<sub>1-10</sub>-Alkylcarbonyl, C<sub>1-6</sub>-Alkylaminocarbonyl,

C<sub>1-10</sub>-Alkylthiocarbonyl, C<sub>1-6</sub>-Dialkylaminocarbonyl,

C<sub>1-10</sub>-Alkoxythiocarbonyl, Aryl-C<sub>1-6</sub>-alkylaminocarbonyl,

C<sub>1-10</sub>-Alkoxycarbonyl,

C<sub>4-10</sub>-Aralkylcarbonyl,

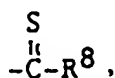
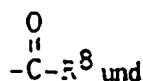
C<sub>4-10</sub>-Aralkoxycarbonyl,

C<sub>1-10</sub>-Carboxylalkyl ist und

weiterhin, wobei jeder der Substituenten für R<sup>4</sup> mit einem oder mehreren Substituenten substituiert sein kann, die ausgewählt sind aus der Gruppe, wie sie für R<sup>6</sup> definiert ist, oder durch eine L- oder D-Aminosäure, die durch eine Amidbindung angefügt wird;

R<sup>5</sup>

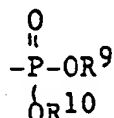
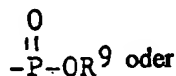
ein vier- bis achtgliedriger gesättigter oder ungesättigter heterocyclischer Ring, der 1, 2, 3 oder 4 Heteroatome enthält, wobei diese Heteroatome N, O oder S sind, oder



wobei R<sup>8</sup>

Hydroxy,

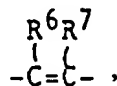
$C_{1-10}$ -Alkyloxy,  
 $C_{1-10}$ -Alkaryloxy,  
 $C_{4-10}$ -Aralkyloxy,  
 $C_{4-10}$ -Aralkylcarbonyloxy,  
 $C_{1-10}$ -Alkoxyalkyloxy,  
 $C_{1-10}$ -Alkoxyalkylcarbonyloxy,  
 $C_{1-10}$ -Alkoxycarbonyloxyalkyl,  
 $C_{1-10}$ -Alkylcarbonyloxyalkyloxy,  
 eine durch eine Amidbindung angefügte L- oder D-Aminosäure ist und wobei der Carbonsäureanteil  
 dieser Aminosäure als die freie Säure vorliegt oder mit  $C_{1-6}$ -Alkyl verestert ist,



ist, wobei  $R^9$  und  $R^{10}$  ausgewählt sind aus der Gruppe, die aus Wasserstoff,  $C_{1-10}$ -Alkyl und  $C_{4-10}$ -Aralkyl besteht;

X und Y wählweise Substituenten sind, die, wenn vorhanden,

O,  
 S,  
 SO,  
 SO<sub>2</sub>.



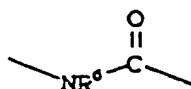
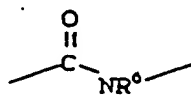
-C=C-

Oxo,

Aryl,

Thiono,

unsubstituiertes oder substituiertes  $C_{1-15}$ -Alkyl oder Cycloalkyl, wobei die Substituenten unabhängig voneinander  $R^6$  und  $R^7$  sind,



-NR<sup>6</sup>-SO<sub>2</sub>-, -SO<sub>2</sub>-NR<sup>6</sup>- oder

ein 4- bis 8-gliedriger heterocyclischer Ring sind, der 1, 2, 3 oder 4 Heteroatome enthält, wobei die Atome N, O oder S sind und wobei der Ring an jedem beliebigen Atom unabhängig voneinander mit  $R^6$  substituiert ist;

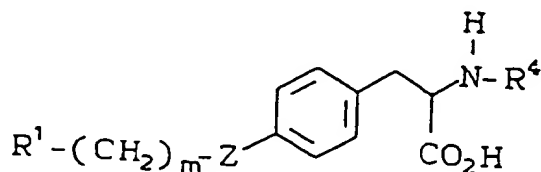
Z ein wählweise Substituent ist, der, wenn vorhanden, unabhängig aus der Gruppe ausgewählt ist, wie sie für X und Y definiert ist;

m eine ganze Zahl von null bis zehn ist;

n eine ganze Zahl von null bis zehn ist; und

p eine ganze Zahl von null bis drei ist.

7. Die Verwendung einer wie in Anspruch 6 definierten Verbindung für die Herstellung eines Medikamentes zur Vorbeugung oder Behandlung von Thrombus- und Embolusbildung.
8. Die Verwendung einer wie in Anspruch 6 definierten Verbindung für die Herstellung eines Medikamentes zur Hemmung der Aggregation von Blutplättchen.
9. Die Verwendung einer wie in Anspruch 6 definierten Verbindung zusammen mit einem Antikoagulans für die Herstellung eines Medikamentes zur Vorbeugung oder Behandlung von Thrombus- und Embolusbildung.
10. Die Verwendung einer wie in Anspruch 6 definierten Verbindung zusammen mit einem Antikoagulans für die Herstellung eines Medikamentes zur Hemmung der Aggregation von Blutplättchen.
11. Die Verwendung einer wie in Anspruch 6 definierten Verbindung zusammen mit einem Thrombolytikum für die Herstellung eines Medikamentes zur Vorbeugung oder Behandlung von Thrombus- und Embolusbildung.
12. Die Verwendung einer wie in Anspruch 6 definierten Verbindung zusammen mit einem Thrombolytikum für die Herstellung eines Medikamentes zur Hemmung der Aggregation von Blutplättchen.
13. Die Verwendung einer wie in Anspruch 6 definierten Verbindung zusammen mit einem Mittel gegen die Plättchenaggregation für die Herstellung eines Medikamentes zur Vorbeugung oder Behandlung von Thrombus- und Embolusbildung.
14. Die Verwendung einer wie in Anspruch 6 definierten Verbindung zusammen mit einem Mittel gegen die Plättchenaggregation für die Herstellung eines Medikamentes zur Hemmung der Aggregation von Blutplättchen.
15. Eine pharmazeutische Zusammensetzung, umfassend eine Verbindung, wie sie in Anspruch 6 definiert ist, und einen pharmazeutisch verträglichen Träger.
16. Eine pharmazeutische Zusammensetzung, umfassend eine Verbindung, wie sie in Anspruch 6 definiert ist, einen pharmazeutisch verträglichen Träger und eine Verbindung aus der Gruppe, die aus Thrombolytika, Mitteln gegen die Plättchenaggregation und Antikoagulantien besteht.
17. Die Zusammensetzung, wie in Anspruch 15 oder Anspruch 16 beansprucht, bei der der pharmazeutisch verträgliche Träger aus einer pharmazeutischen Formulierung mit verzögerter Freisetzung besteht.
18. Die in Anspruch 6 definierten Verbindungen zur Verwendung bei der Hemmung der Bindung von Fibrinogen an Blutplättchen, der Hemmung der Aggregation von Blutplättchen, der Behandlung von Thrombusbildung oder Embolusbildung oder der Vorbeugung von Thrombus- oder Embolusbildung bei einem Säuger.
19. Die Verbindungen nach Anspruch 5 zur Verwendung bei der Hemmung der Bindung von Fibrinogen an Blutplättchen, der Hemmung der Aggregation von Blutplättchen, der Behandlung von Thrombusbildung oder Embolusbildung oder der Vorbeugung von Thrombus- oder Embolusbildung bei einem Säuger.
20. Eine Verbindung, wie in Anspruch 1 beansprucht, der Formel



wobei

R<sup>1</sup> ein fünf- oder 6-gliedriger heterocyclischer Ring, wobei das Heteroatom N ist und wobei der heterocyclische Ring gegebenenfalls mit Wasserstoff oder C<sub>1-5</sub>-Alkyl substituiert ist, oder NR<sup>6</sup>R<sup>7</sup> ist, wobei R<sup>6</sup> und R<sup>7</sup> unabhängig voneinander Wasserstoff, C<sub>1-10</sub>-Alkyl oder C<sub>4-10</sub>-Arylalkyl sind;

R<sup>4</sup> Arylcarbonyl,  
 C<sub>1-10</sub>-Alkylcarbonyl,  
 C<sub>1-10</sub>-Alkoxy carbonyl,  
 C<sub>4-10</sub>-Aralkylcarbonyl,  
 C<sub>4-10</sub>-Aralkoxy carbonyl ist, wobei R<sup>4</sup> unsubstituiert oder mit R<sup>6</sup>, wie vorstehend definiert, substituiert ist;  
 Z ausgewählt ist aus:  
 O, -NR<sup>6</sup>CO-, -CONR<sup>6</sup>- oder CH<sub>2</sub>; und  
 m eine ganze Zahl von eins bis sechs ist;

mit der Ausnahme von:

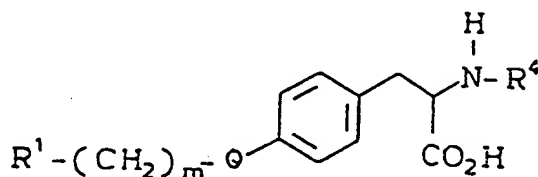
N-tert.-Butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosin;

N-tert.-Butoxycarbonyl-O-(3-aminopropyl)-L-tyrosin;

N-tert.-Butoxycarbonyl-O-(3-tert.-butoxycarbonylaminopropyl)-L-tyrosin und  
 α-Benzoylamino-4-(2-diethylaminoethoxy)benzolpropionsäure.

#### Patentansprüche für folgende Vertragsstaaten : ES, GR

##### 1. Ein Verfahren zur Herstellung einer Verbindung der Formel



oder eines pharmazeutisch verträglichen Salzes davon, wobei

R<sup>1</sup> ein fünf- oder 6-gliedriger heterocyclischer Ring, wobei das Heteroatom N ist und wobei der heterocyclische Ring gegebenenfalls mit Wasserstoff oder C<sub>1-5</sub>-Alkyl substituiert ist, oder NR<sup>6</sup>R<sup>7</sup> ist, wobei R<sup>6</sup> und R<sup>7</sup> unabhängig voneinander Wasserstoff, C<sub>1-10</sub>-Alkyl oder C<sub>4-10</sub>-Arylalkyl sind;

R<sup>4</sup> Arylcarbonyl,  
 C<sub>1-10</sub>-Alkylcarbonyl,  
 C<sub>1-10</sub>-Alkoxy carbonyl,  
 C<sub>4-10</sub>-Aralkylcarbonyl,  
 C<sub>4-10</sub>-Aralkoxy carbonyl, ist, wobei R<sup>4</sup> unsubstituiert oder mit R<sup>6</sup>, wie vorstehend definiert, substituiert ist; und  
 m eine ganze Zahl von eins bis sechs ist;

mit der Ausnahme von:

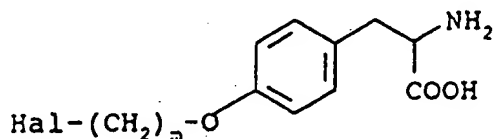
N-tert.-Butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosin;

N-tert.-Butoxycarbonyl-O-(3-aminopropyl)-L-tyrosin;

N-tert.-Butoxycarbonyl-O-(3-tert.-butoxycarbonylaminopropyl)-L-tyrosin und  
 α-Benzoylamino-4-(2-diethylaminoethoxy)benzolpropionsäure;

umfassend:

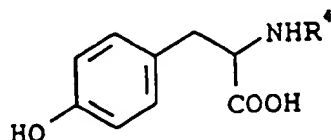
Umsetzen einer Verbindung der Formel



oder eines ihrer geschützten Derivate, wobei Hal ein Halogenatom ist, mit einer Verbindung der Formel  $R^1-H$ ; gefolgt von, wenn nötig, der Entfernung jeder Schutzgruppe, falls eine solche vorhanden ist.

2. Ein Verfahren, wie in Anspruch 1 beansprucht, das umfaßt:

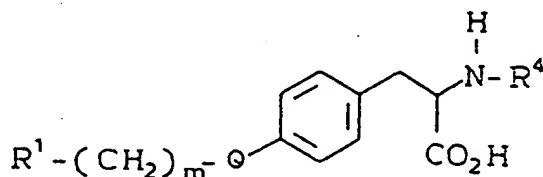
1) Umsetzen einer Verbindung der Formel



oder eines ihrer geschützten Derivate mit einer Verbindung der Formel  $Hal-(CH_2)_m-Hal$ , wobei Hal ein Halogenatom ist, in Gegenwart einer Base; und

2) Umsetzen des Produktes aus Schritt 1) mit einer Verbindung der Formel  $R^1-H$ ; gefolgt von, wenn nötig, der Entfernung jeder Schutzgruppe, falls eine solche vorhanden ist.

3. Ein Verfahren zur Herstellung einer Verbindung der Formel



oder eines pharmazeutisch verträglichen Salzes davon, wobei

$R^1$

ein fünf- oder 6-gliedriger heterocyclischer Ring, wobei das Heteroatom N ist und wobei der heterocyclische Ring gegebenenfalls mit Wasserstoff oder  $C_{1-5}$ -Alkyl substituiert ist, oder  $NR^6R^7$  ist, wobei  $R^6$  und  $R^7$  unabhängig voneinander

Wasserstoff,  $C_{1-10}$ -Alkyl oder  $C_{4-10}$ -Arylalkyl sind;

$R^4$

Arylcarbonyl,

$C_{1-10}$ -Alkylcarbonyl,

$C_{1-10}$ -Alkoxycarbonyl,

$C_{4-10}$ -Aralkylcarbonyl,

$C_{4-10}$ -Aralkoxycarbonyl ist, wobei  $R^4$  unsubstituiert oder mit  $R^6$ , wie vorstehend definiert, substituiert ist; und

$m$  eine ganze Zahl von eins bis sechs ist;

mit der Ausnahme von:

N-tert.-Butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosin;

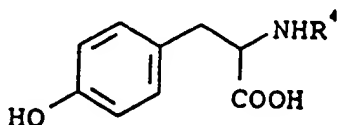
N-tert.-Butoxycarbonyl-O-(3-aminopropyl)-L-tyrosin;

N-tert.-Butoxycarbonyl-O-(3-tert.-butoxycarbonylaminopropyl)-L-tyrosin und

$\alpha$ -Benzoylamino-4-(2-diethylaminoethoxy)benzolpropionsäure;

umfassend:

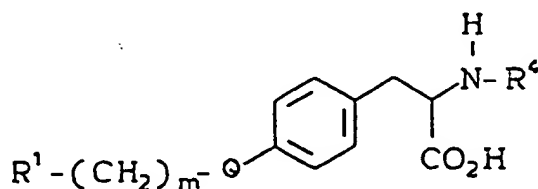
Umsetzen einer Verbindung der Formel





oder eines ihrer geschützten Derivate mit einer Verbindung der Formel  $R^1-(CH_2)_m-Hal$  oder einem ihrer geschützten Derivate, wobei Hal ein Halogenatom ist, in Gegenwart einer Base; gefolgt von, wenn nötig, der Entfernung jeder Schutzgruppe, falls eine solche vorhanden ist.

4. Ein Verfahren zur Herstellung einer Verbindung der Formel



oder eines pharmazeutisch verträglichen Salzes davon, wobei

$R^1$

ein fünf- oder 6-gliedriger heterocyclischer Ring, wobei das Heteroatom N ist und wobei der heterocyclische Ring gegebenenfalls mit Wasserstoff oder  $C_{1-5}$ -Alkyl substituiert ist, oder  $NR^6R^7$  ist, wobei  $R^6$  und  $R^7$  unabhängig voneinander Wasserstoff,  $C_{1-10}$ -Alkyl oder  $C_{4-10}$ -Arylalkyl sind;

$R^4$

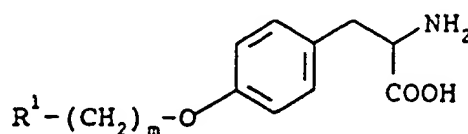
Arylcarbonyl,  
 $C_{1-10}$ -Alkylcarbonyl,  
 $C_{1-10}$ -Alkoxycarbonyl,  
 $C_{4-10}$ -Aralkylcarbonyl,  
 $C_{4-10}$ -Aralkoxycarbonyl, ist, wobei  $R^4$  unsubstituiert oder mit  $R^6$ , wie vorstehend definiert, substituiert ist; und

$m$  eine ganze Zahl von eins bis sechs ist;

mit der Ausnahme von:

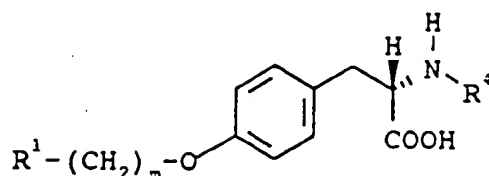
N-tert.-Butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosin;  
 N-tert.-Butoxycarbonyl-O-(3-aminopropyl)-L-tyrosin;  
 N-tert.-Butoxycarbonyl-O-(3-tert.-butoxycarbonylaminopropyl)-L-tyrosin und  
 $\alpha$ -Benzoylamino-4-(2-diethylaminoethoxy)benzolpropionsäure;  
 umfassend:

Umsetzen einer Verbindung der Formel



oder eines ihrer geschützten Derivate mit einer Verbindung der Formel  $R'CO_2H$  oder einem ihrer aktivierten Acylhalogenid-Derivate (wobei  $R'$  Aryl,  $C_{1-10}$ -Alkyl,  $C_{1-10}$ -Alkoxy,  $C_{4-10}$ -Aralkyl oder  $C_{4-10}$ -Aralkoxy ist, von denen jedes unsubstituiert oder mit  $R^6$ , wie vorstehend definiert, substituiert sein kann); gefolgt von, wenn nötig, der Entfernung jeder Schutzgruppe, falls eine solche vorhanden ist.

5. Ein wie in irgendeinem der Ansprüche 1 bis 4 beanspruchtes Verfahren für die Herstellung einer Verbindung der Formel



wobei  $\text{R}^1$ ,  $\text{R}^4$  und  $m$  wie in Anspruch 1 definiert sind, oder eines pharmazeutisch verträglichen Salzes davon.

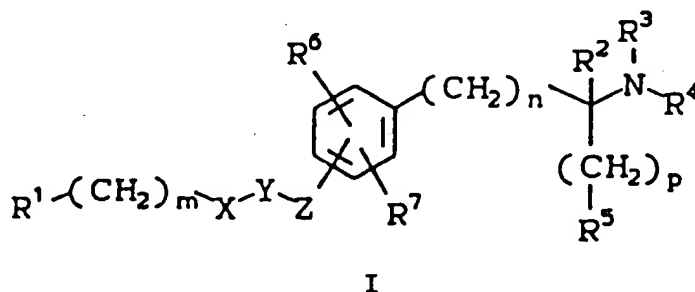
6. Ein wie in irgendeinem der Ansprüche 1 bis 4 beanspruchtes Verfahren für die Herstellung einer Verbindung, die ausgewählt ist aus der Gruppe, bestehend aus:

2-S-(N-Benzoyloxycarbonylamino)-3-[4-(3-N-pyrrolidinylpropyloxy)phenyl]propionsäure;  
 2-S-(N-Benzoyloxycarbonylamino)-3-[4-(4-piperazinyl)butyloxyphenyl]propionsäure;  
 2-S-(N-Benzoyloxycarbonylamino)-3-[4-(4-methylpiperazin-1-yl)propyloxyphenyl]propionsäure;  
 2-S-(N-Benzoyloxycarbonylamino)-3-[4-(4-piperazin-1-yl)pentyloxyphenyl]propionsäure;  
 2-S-(N-Benzoyloxycarbonylamino)-3-[4-(4-piperidinyl)butyloxyphenyl]propionsäure;  
 2-S-(N-Benzoyloxycarbonylamino)-3-[4-(4-piperidinyl)but-2-enyloxyphenyl]propionsäure;  
 2-S-(Pentanoylamino)-3-[4-(4-piperidin-4-ylbutyloxy)phenyl]propionsäurehydrochlorid;  
 2-S-(Hexanoylamino)-3-[4-(4-piperidin-4-ylbutyloxy)phenyl]propionsäure;  
 oder eines pharmazeutisch verträglichen Salzes davon.

## Revendications

Revendications pour les Etats contractants suivants : AT, BE, CH, DE, DK, FR, GB, IT, LI, LU, NL, SE

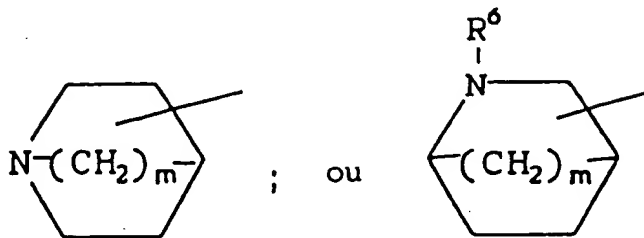
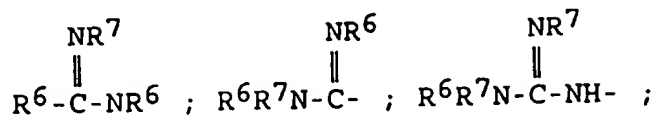
1. Composé de formule :



et ses sels acceptables en pharmacie,  
 formule dans laquelle :

$\text{R}^1$  est :  
 un noyau hétérocyclique à 4 à 8 chaînons, contenant 1, 2, 3 ou 4 hétéroatomes, ces hétéroatomes étant N, O ou S, et ledit noyau hétérocyclique étant éventuellement substitué, au niveau de l'un quel-

conque de ses atomes, par H, R<sup>6</sup> ou R<sup>7</sup> ;



NR<sup>6</sup>R<sup>7</sup>, où R<sup>6</sup> et R<sup>7</sup> sont indépendamment :

l'hydrogène, un groupe (alcoxy en C<sub>1</sub>-C<sub>10</sub>) carbonyle ou un groupe cycloalkyle ou alkyle en C<sub>1</sub>-C<sub>10</sub> éventuellement substitué, lesdits substituants étant :

des radicaux alcoxy en C<sub>1</sub>-C<sub>10</sub>, alcoxyalkyle en C<sub>1</sub>-C<sub>10</sub>, alcoxyalkyloxy en C<sub>1</sub>-C<sub>10</sub>, alcoxycarbonyle en C<sub>1</sub>-C<sub>10</sub>, alkylcarbonyle en C<sub>1</sub>-C<sub>10</sub>, alkylaminocarbonyle en C<sub>0</sub>-C<sub>6</sub>, aralkylcarbonyle en C<sub>1</sub>-C<sub>10</sub>, alkylthiocarbonyle en C<sub>1</sub>-C<sub>10</sub>, aralkylthiocarbonyle en C<sub>4</sub>-C<sub>10</sub>, thiocarbonyle, alcoxylthiocarbonyle en C<sub>1</sub>-C<sub>10</sub>, aryle, des noyaux hétérocycliques saturés à 5 ou 6 chaînons comprenant 1, 2, 3 ou 4 hétéroatomes, lesdits hétéroatomes étant choisis dans l'ensemble constitué par N, O et S, des radicaux alcanoylamino en C<sub>1</sub>-C<sub>4</sub>, (alcoxycarbonyl en C<sub>1</sub>-C<sub>6</sub>)-(alkylamino en C<sub>0</sub>-C<sub>6</sub>), alkylsulfonylamino en C<sub>1</sub>-C<sub>10</sub>, aralkylsulfonylamino en C<sub>4</sub>-C<sub>10</sub>, aralkyle en C<sub>4</sub>-C<sub>10</sub>, alcaryle en C<sub>1</sub>-C<sub>10</sub>, alkylthio en C<sub>1</sub>-C<sub>10</sub>, aralkylthio en C<sub>4</sub>-C<sub>10</sub>, alkylsulfinyle en C<sub>1</sub>-C<sub>10</sub>, aralkylsulfinyle en C<sub>4</sub>-C<sub>10</sub>, alkylsulfonyle en C<sub>1</sub>-C<sub>10</sub>, aralkylsulfonyle en C<sub>4</sub>-C<sub>10</sub>, aminosulfonyle, alkylaminosulfonyle en C<sub>1</sub>-C<sub>10</sub>, aralkylsulfonylamino en C<sub>4</sub>-C<sub>10</sub>, oxo, thio, des radicaux 1-éthényle, 2-éthényle ou 3-propényle non substitués, monosubstitués ou disubstitués, lesdits substituants étant choisis dans le groupe constitué par l'hydrogène, les radicaux alkyle en C<sub>1</sub>-C<sub>10</sub> et aralkyle en C<sub>7</sub>-C<sub>10</sub>, des radicaux carboxy, hydroxy, amino, alkylamino en C<sub>1</sub>-C<sub>6</sub>, dialkylamino en C<sub>1</sub>-C<sub>6</sub>, des atomes halogène, ceux-ci étant définis par Cl, F, Br et I, des radicaux nitro ou cyano, et de plus où ledit atome d'azote peut en outre être substitué pour former un ion ammonium quaternaire dans lequel ledit substituant est tel que défini au préalable pour R<sup>6</sup> et R<sup>7</sup> ;

R<sup>2</sup> et R<sup>3</sup> sont indépendamment :

l'hydrogène, un radical aryle ou un groupe cycloalkyle ou alkyle en C<sub>0</sub>-C<sub>10</sub> éventuellement substitué, ledit substituant étant :

un radical alcoxyalkyle en C<sub>1</sub>-C<sub>10</sub>, aryle, un noyau hétérocyclique à 4 à 8 chaînons contenant 1, 2, 3 ou 4 hétéroatomes, lesdits hétéroatomes étant choisis parmi l'ensemble constitué par N, O et S, un radical aralkyle en C<sub>4</sub>-C<sub>10</sub>, alcaryle en C<sub>1</sub>-C<sub>10</sub>, carboxy, alkylcarbonyle en C<sub>1</sub>-C<sub>10</sub>, alkylthiocarbonyle en C<sub>1</sub>-C<sub>10</sub>, aralkylcarbonyle en C<sub>4</sub>-C<sub>10</sub>, aralkylthiocarbonyle en C<sub>4</sub>-C<sub>10</sub>, alcoxycarbonyle en C<sub>1</sub>-C<sub>6</sub>, aralcoxycarbonyle en C<sub>4</sub>-C<sub>10</sub>, alcoxy en C<sub>1</sub>-C<sub>6</sub>, aralcoxy en C<sub>4</sub>-C<sub>10</sub>, alkylamino en C<sub>1</sub>-C<sub>6</sub>, dialkylamino en C<sub>1</sub>-C<sub>12</sub>, alcanoylamino en C<sub>1</sub>-C<sub>6</sub>, aralcanoylamino en C<sub>4</sub>-C<sub>12</sub>, aralkylamino en C<sub>4</sub>-C<sub>10</sub> ;

R<sup>4</sup> est :

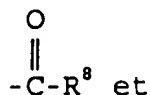
l'hydrogène, un radical aryle, cycloalkyle ou alkyle en C<sub>1</sub>-C<sub>10</sub>, aralkyle en C<sub>4</sub>-C<sub>10</sub>, arylcarbonyle, aminocarbonyle, alkylcarbonyle en C<sub>1</sub>-C<sub>10</sub>, alkylaminocarbonyle en C<sub>1</sub>-C<sub>6</sub>, alkylthiocarbonyle en C<sub>1</sub>-C<sub>10</sub>, dialkylaminocarbonyle en C<sub>1</sub>-C<sub>6</sub>, alcoxylthiocarbonyle en C<sub>1</sub>-C<sub>10</sub>, aryl-(alkyl en C<sub>1</sub>-C<sub>6</sub>) aminocarbonyle, alcoxycarbonyle en C<sub>1</sub>-C<sub>10</sub>, aralkylcarbonyle en C<sub>4</sub>-C<sub>10</sub>, aralcoxycarbonyle en C<sub>4</sub>-C<sub>10</sub>, carboxyalkyle en C<sub>1</sub>-C<sub>10</sub>, et

en outre, dans lequel l'un quelconque des substituants de R<sup>4</sup> peut être substitué par un ou plusieurs substituants choisis dans l'ensemble défini pour R<sup>6</sup>, ou par un acide L-aminé ou D-aminé réuni par une liaison amide ;

R<sup>5</sup> est :

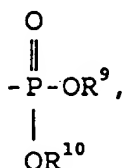
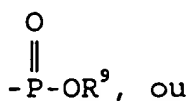
un noyau hétérocyclique saturé ou insaturé à 4 à 8 chaînons, contenant 1, 2, 3 ou 4 hétéroatomes,

lesdits hétéroatomes étant N, O ou S, ou



où  $\text{R}^8$  est un radical :

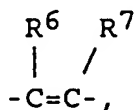
hydroxy, alkyloxy en  $\text{C}_1\text{-C}_{10}$ , alcaryloxy en  $\text{C}_1\text{-C}_{10}$ , aralkyloxy en  $\text{C}_4\text{-C}_{10}$ , aralkylcarbonyloxy en  $\text{C}_4\text{-C}_{10}$ , alcoxyalkyloxy en  $\text{C}_1\text{-C}_{10}$ , alcoxyalkylcarbonyloxy en  $\text{C}_1\text{-C}_{10}$ , alcoxycarbonyloxyalkyle en  $\text{C}_1\text{-C}_{10}$ , alkylcarbonyloxyalkyloxy en  $\text{C}_1\text{-C}_{10}$ , un acide L- ou D-aminé réuni par une liaison amide, et où le fragment acide carboxylique dudit acide aminé est sous forme acide libre ou est estérifié par un radical alkyle en  $\text{C}_1\text{-C}_6$  ;



où  $\text{R}^9$  et  $\text{R}^{10}$  sont choisis dans l'ensemble constitué par :

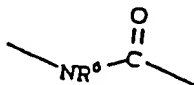
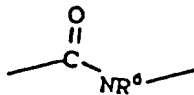
l'hydrogène et les radicaux alkyle en  $\text{C}_1\text{-C}_{10}$  et aralkyle en  $\text{C}_4\text{-C}_{10}$  ;

X et Y sont des substituants facultatifs qui, lorsqu'ils sont présents, sont :  $\text{NR}^6$ , O, S, SO,  $\text{SO}_2$ ,



$-\text{C}=\text{C}-$ , oxo, aryle, thiono,

un radical cycloalkyle ou alkyle en  $\text{C}_1\text{-C}_{15}$  éventuellement substitué, lesdits substituants étant indépendamment  $\text{R}^6$  et  $\text{R}^7$ ,



$-\text{NR}^6\text{-SO}_2-$ ,  $-\text{SO}_2\text{-NR}^6-$ , ou un noyau hétérocyclique à 4 à 8 chaînons contenant 1, 2, 3 ou 4 hétéroatomes, lesdits atomes étant N, O ou S, et ledit noyau étant indépendamment substitué, au niveau d'un atome quelconque, par  $\text{R}^6$  ;

Z est un substituant facultatif qui, lorsqu'il est présent, est choisi indépendamment parmi les définitions données pour X et Y ;  
 m est un entier de 0 à 10 ;  
 n est un entier de 0 à 10 ; et  
 p est un entier de 0 à 3 ;

à l'exception de :

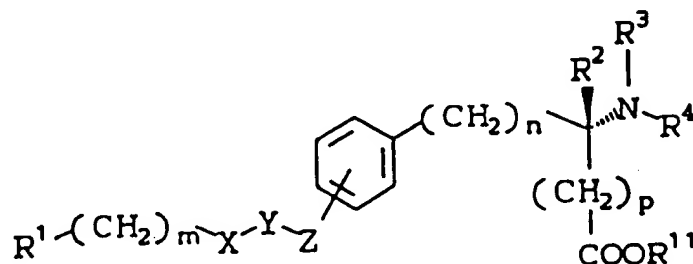
la N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine,

la N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine,

la N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminopropyl)-L-tyrosine, et

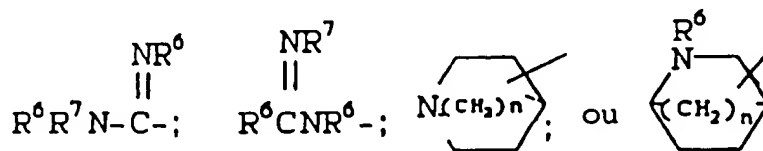
l'acide  $\alpha$ -benzoylamino-4-(2-diéthylaminoéthoxy)benzèneprépanoïque.

## 2. Composé ayant la formule développée :



et ses sels acceptables en pharmacie,  
 formule dans laquelle :

R¹ est :  
 un noyau hétérocyclique à 4 à 8 chaînons contenant 1, 2, 3 ou 4 hétéroatomes, lesdits hétéroatomes étant N, O ou S, et ledit noyau hétérocyclique étant éventuellement substitué par l'hydrogène ou un radical alkyle en C₁-C₁₀ ; ou  
 NR⁶R⁷, où R⁶ et R⁷ sont indépendamment l'hydrogène ou un groupe alcoxycarbonyle en C₁-C₁₀ ou alkyle en C₁-C₁₀ éventuellement substitué, ledit substituant étant :  
 un radical alkoxy en C₁-C₁₀, alcoxycarbonyle en C₁-C₁₀, aryle, aralkyle en C₄-C₁₀, alcaryle en C₁-C₁₀, carboxy, hydroxy ou amino,



et de plus où ledit atome d'azote peut en outre être substitué pour former un ion ammonium quaternaire ;  
 R² et R³ sont indépendamment l'hydrogène, un radical alkyle en C₁-C₁₀ ou aralkyle en C₄-C₁₀ ;

R⁴ est :  
 l'hydrogène, un radical alkyle en C₁-C₁₀, aralkyle en C₄-C₁₀, arylcarbonyle, aralkylcarbonyle, alkylcarbonyle en C₁-C₁₀, alcoxycarbonyle en C₁-C₁₀, aralkylcarbonyle en C₄-C₁₀, ou aralcoxycarbonyle en C₄-C₁₀,  
 et de plus où l'un quelconque des substituants de R⁴ peut être substitué par un ou plusieurs des substituants du groupe défini pour R⁶ dans la revendication 1 ;

R¹¹ est l'hydrogène ou un radical alkyle en C₁-C₁₀ ;

X et Y sont indépendamment :

O, S, SO, SO₂, un radical aryle, -CH=CH-, oxo -C(=O)-NR⁶, -NR⁶-C(=O)-, -NR⁶SO₂- ou -SO₂NR⁶, un groupe alkyle à chaîne droite ou ramifiée en C₁-C₁₅ éventuellement substitué par :

un radical carboxy, hydroxy, alkoxy en C₁-C₁₀ ou un noyau hétérocyclique à 4 à 6 chaînons contenant 1, 2 ou 3 hétéroatomes choisis parmi N, O et S,

- Z est un substituant facultatif qui, lorsqu'il est présent, est O, SO<sub>2</sub>, -NR<sup>6</sup>CO-, -CONR<sup>6</sup>, -C(=O)- ou un radical alkyle en C<sub>1</sub>-C<sub>10</sub> à chaîne droite ou ramifiée ;
- m est un entier de 0 à 6 ;
- n est un entier de 0 à 6 ; et
- 5 p est un entier de 0 à 3 ;

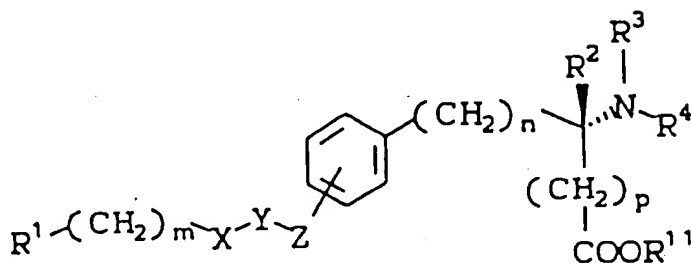
à l'exception de :

la N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine,

la N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine,

- 10 la N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminopropyl)-L-tyrosine, et l'acide α-benzoylamino-4-(2-diéthylaminoéthoxy)benzènepropanoïque.

### 3. Composé ayant la formule développée :

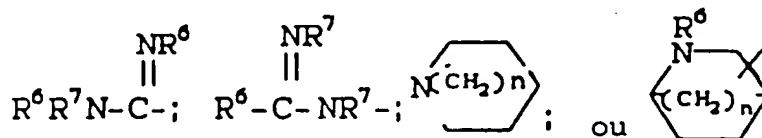


et ses sels acceptables en pharmacie,  
formule dans laquelle

R<sup>1</sup> est :

30 un noyau hétérocyclique à 5 à 6 chaînons contenant 1 ou 2 hétéroatomes, lesdits hétéroatomes étant l'azote, et ledit noyau hétérocyclique étant éventuellement substitué par un radical alkyle en C<sub>1</sub>-C<sub>5</sub> ; ou NR<sup>6</sup>R<sup>7</sup>, où R<sup>6</sup> et R<sup>7</sup> sont indépendamment l'hydrogène ou un groupe alkyle en C<sub>1</sub>-C<sub>10</sub> éventuellement substitué, ledit substituant étant :

un radical alcoxycarbonyle en C<sub>1</sub>-C<sub>10</sub>, aryle ou aralkyle en C<sub>4</sub>-C<sub>10</sub>.



et de plus où ledit atome d'azote peut en outre être substitué pour former un ion ammonium quaternaire ;

R<sup>2</sup> et R<sup>3</sup> sont l'hydrogène ;

R<sup>4</sup> est :

45 un radical arylcarbonyle, alkylcarbonyle en C<sub>1</sub>-C<sub>10</sub>, aralkylcarbonyle, alcoxycarbonyle en C<sub>1</sub>-C<sub>10</sub>, aralkylcarbonyle en C<sub>4</sub>-C<sub>10</sub>, ou aralcoxycarbonyle en C<sub>4</sub>-C<sub>10</sub>, et en outre où les substituants pour R<sup>4</sup> peuvent être éventuellement substitués par un ou plusieurs substituants choisis dans l'ensemble défini pour R<sup>6</sup> dans la revendication 1 ;

50 R<sup>11</sup> est l'hydrogène ou un radical alkyle en C<sub>1</sub>-C<sub>10</sub> ;

X et Y sont indépendamment :

O, SO<sub>2</sub>, un radical aryle, NR<sup>6</sup>-CO-, CONR<sup>6</sup>- ou -CH=CH-, un radical alkyle cyclique, ramifié ou droit en C<sub>1</sub>-C<sub>15</sub> éventuellement substitué, ledit substituant étant un radical hydroxy, ou un noyau hétérocyclique à 4 à 6 chaînons contenant 1 ou 2 hétéroatomes choisis parmi N, O et S ;

55 Z est un substituant facultatif qui, lorsqu'il est présent, est O ou un radical alkyle en C<sub>1</sub>-C<sub>10</sub> à chaîne droite ou ramifiée ;

m est un entier de 0 à 6 ;

n est un entier de 0 à 1 ; et

p est un entier de 0 à 1 ;

à l'exception de :

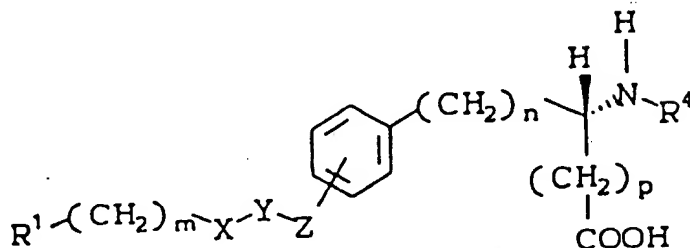
la N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine,

la N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine,

la N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminopropyl)-L-tyrosine, et

l'acide  $\alpha$ -benzoylamino-4-(2-diéthylaminoéthoxy)benzènepropanoïque.

4. Composé ayant la formule développée :



et ses sels acceptables en pharmacie,  
formule dans laquelle :

R¹ est :

un noyau hétérocyclique à 6 chaînons contenant 1 ou 2 hétéroatomes, lesdits atomes hétérocycliques étant l'azote et ledit noyau hétérocyclique étant éventuellement substitué par un radical alkyle en C₁-C₅

; ou

NR⁶R⁷, où R⁶ et R⁷ sont indépendamment l'hydrogène ou un groupe alkyle en C₁-C₁₀ ;

R⁴ est :

un radical arylcarbonyl, alkylcarbonyl en C₁-C₁₀, aralkylcarbonyl en C₄-C₁₀, alcoxycarbonyl en C₁-C₁₀, ou aralcoxycarbonyl en C₄-C₁₀, et en outre où l'un quelconque des substituants pour R⁴ peut être substitué par un ou plusieurs substituants de l'ensemble défini pour R⁶ dans la revendication 1 ;

X et Y sont indépendamment

O, SO₂, un radical aryle, -NR⁶-C(=O), -C(=O)-NR⁶, -CH=CH- ou un groupe alkyle à chaîne droite ou ramifiée en C₁-C₁₀ ;

Z est un substituant facultatif qui, lorsqu'il est présent, est O ou un radical alkyle en C₁-C₅ à chaîne droite ou ramifiée ;

m est un entier de 0 à 6 ;

n vaut 1 ; et

p vaut 0 ;

à l'exception de :

la N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine,

la N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine,

la N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminopropyl)-L-tyrosine, et

l'acide  $\alpha$ -benzoylamino-4-(2-diéthylaminoéthoxy)benzènepropanoïque.

5. Composé selon la revendication 1, choisi dans le groupe constitué par :

l'acide 2-S-(6-N-benzyloxycarbonylamino)-3-[4-(3-chloropropoxy)phényl]propionique ;

l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(N,N,2,2-tétraméthyl-1,3-propanediamino)propoxyphényl]propionique ;

l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(3-N-pyrrolidinylpropoxy)phényl]propionique ;

l'acide 2-S-(N-benzyloxycarbonylamino)-[4-(3-N-méthyl-N-benzylaminopropoxyphényl)]propionique ;

l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(4-pipérazinyl)butyloxyphényl]propionique ;

l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(1,1,4,4-tétraméthylbutylamino)propoxyphényl]propionique ;

l'acide 2-S-(N-benzyloxycarbonyl)-3-[4-(4-méthylpipérazine-1-yl)propoxyphényl]propanoïque ;

l'acide 2-(N-benzyloxycarbonylamino)-3-[4-(5-bromopentyloxy)phényl]propionique ;

l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(4-pipérazine-1-yl)pentyloxyphényl]propionique ;

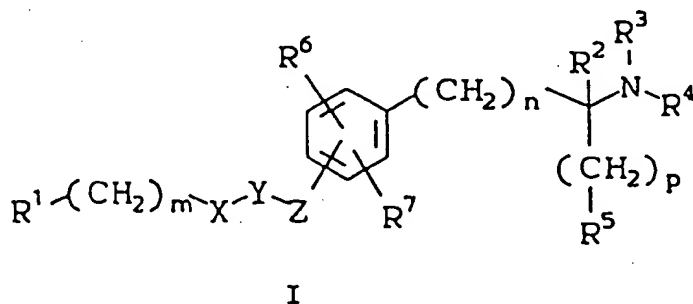
le chlorhydrate de l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(6-aminohexyloxyphényl)]propionique ;

le chlorhydrate de l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(7-aminoheptyloxy)phényl]propionique ;

l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(8-amino-octyloxy)phényl]propionique ;

le chlorhydrate de l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(5-aminopentyloxy)phényl]propionique ;  
 l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(4-pipéridinylbutyloxy)phényl]propionique ;  
 le chlorhydrate de l'acide 2-S-phénylcarbonylamino-3-[4-(6-aminohexyloxy)phényl]propionique ;  
 le chlorhydrate de l'acide 2-S-phénéthylcarbonylamino-3-[4-(6-aminohexyloxy)phényl]propionique ;  
 l'acide 2-S-(phénylacétylamino)-3-[4-(6-aminohexyloxy)phényl]propionique ;  
 l'acide 2-S-(2-carboxy-3-phénylpropionylamino)-3-[4-(6-aminohexyloxy)phényl]propionique ;  
 le chlorhydrate de l'acide 2-S-(hexanoylamino)-3-[4-(6-aminohexyloxy)phényl]propionique ;  
 l'acide 2-S-(naphtanoylamino)-3-[4-(6-aminohexyloxy)phényl]propionique ;  
 l'acide 2-S-(butanoylamino)-3-[4-(6-aminohexyloxy)phényl]propionique ;  
 le chlorhydrate de l'acide 2-S-(heptanoylamino)-3-[4-(6-aminohexyloxy)phényl]propionique ;  
 l'acide 2-S-(5-phénylpentanoylamino)-3-[4-(6-t-butyloxycarbonylamino)hexyloxy]phényl]propionique ;  
 le chlorhydrate de l'acide 2-S-(5-phénylpentanoylamino)-3-[4-(6-aminohexyloxy)phényl]propionique ;  
 le chlorhydrate de l'acide 2-S-(3-carboxypropanoyl)amino-3-[4-(6-aminohexyloxy)phényl]propionique ;  
 le chlorhydrate de l'acide 2-S-(acétylamino)-3-[4-(6-aminohexyloxy)phényl]propionique ;  
 l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(4-pipéridinyl)-but-2-ényloxyphényl]propionique ;  
 l'acide 2-S-(N-t-butyloxycarbonylamino)-3-[4-(4-hydroxybut-1-ynyl)phényl]propionique ;  
 l'acide 2-S-(N-t-butyloxycarbonylamino)-3-[4-(4-hydroxybutyl)phényl]propionique ;  
 l'acide 2-S-(N-t-butyloxycarbonylamino)-3-[4-(4-t-butylaminobutyl)phényl]propionique ;  
 le chlorhydrate de l'acide 2-S-(pentanoylamino)-3-[4-(4-pipéridine-4-ylbutyloxy)phényl]propionique ;  
 l'acide 2-S-(hexanoylamino)-3-[4-(4-pipéridine-4-ylbutyloxy)phényl]propionique ;  
 le dichlorhydrate de l'acide 2-S-(5-aminopentanoyl)amino-3-[4-(6-aminohexyloxy)phényl]propionique ;  
 le 2-S-(4-carbométhoxybutanoyl)amino-3-[4-(N-t-butyloxycarbonylamino)hexyloxy]phényl]propionate de  
 méthyle ; et  
 l'acide 2-S-(4-carboxybutanoylamino)-3-[4-(6-aminohexyloxy)phényl]propionique.

6. Utilisation d'un composé pour la fabrication d'un médicament pour bloquer le fibrinogène du point de vue de son action au niveau de son site récepteur chez un mammifère, ledit composé ayant la formule :

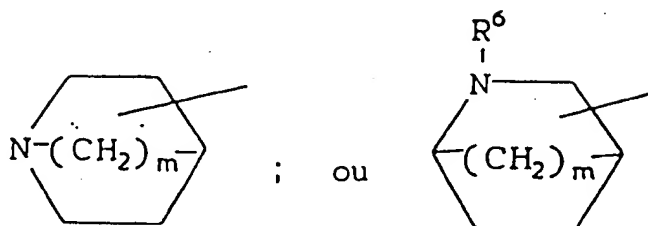
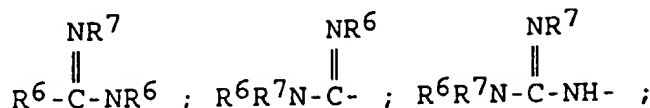


et ses sels acceptables en pharmacie, formule dans laquelle :

R¹ est :  
 un noyau hétérocyclique à 4 à 8 chaînons, contenant 1, 2, 3 ou 4 hétéroatomes, ces hétéroatomes étant N, O ou S, et ledit noyau hétérocyclique étant éventuellement substitué, au niveau de l'un quel-



conque de ses atomes, par H, R<sup>6</sup> ou R<sup>7</sup> ;



NR<sup>6</sup>R<sup>7</sup>, où R<sup>6</sup> et R<sup>7</sup> sont indépendamment :

l'hydrogène, un groupe (alcoxy en C<sub>1</sub>-C<sub>10</sub>) carbonyle ou un groupe cycloalkyle ou alkyle en C<sub>1</sub>-C<sub>10</sub> éventuellement substitué, lesdits substituants étant :

des radicaux alcoxy en C<sub>1</sub>-C<sub>10</sub>, alcoxyalkyle en C<sub>1</sub>-C<sub>10</sub>, alcoxyalkyloxy en C<sub>1</sub>-C<sub>10</sub>, alcoxycarbonyle en C<sub>1</sub>-C<sub>10</sub>, alkylcarbonyle en C<sub>1</sub>-C<sub>10</sub>, alkylaminocarbonyle en C<sub>0</sub>-C<sub>6</sub>, aralkylcarbonyle en C<sub>1</sub>-C<sub>10</sub>, alkylthiocarbonyle en C<sub>1</sub>-C<sub>10</sub>, aralkylthiocarbonyle en C<sub>4</sub>-C<sub>10</sub>, thiocarbonyle, alcoxylthiocarbonyle en C<sub>1</sub>-C<sub>10</sub>, aryle, des noyaux hétérocycliques saturés à 5 ou 6 chaînons comprenant 1, 2, 3 ou 4 hétéroatomes, lesdits hétéroatomes étant choisis dans l'ensemble constitué par N, O et S, des radicaux alcanoylamino en C<sub>1</sub>-C<sub>4</sub>, (alcoxycarbonyl en C<sub>1</sub>-C<sub>6</sub>)-(alkylamino en C<sub>0</sub>-C<sub>6</sub>), alkylsulfonylamino en C<sub>1</sub>-C<sub>10</sub>, aralkylsulfonylamino en C<sub>4</sub>-C<sub>10</sub>, aralkyle en C<sub>4</sub>-C<sub>10</sub>, alcaryle en C<sub>1</sub>-C<sub>10</sub>, alkylthio en C<sub>1</sub>-C<sub>10</sub>, aralkylthio en C<sub>4</sub>-C<sub>10</sub>, alkylsulfinyle en C<sub>1</sub>-C<sub>10</sub>, aralkylsulfinyle en C<sub>4</sub>-C<sub>10</sub>, alkylsulfonyle en C<sub>1</sub>-C<sub>10</sub>, aralkylsulfonyle en C<sub>4</sub>-C<sub>10</sub>, aminosulfonyle, alkylaminosulfonyle en C<sub>1</sub>-C<sub>10</sub>, aralkylsulfonylamino en C<sub>4</sub>-C<sub>10</sub>, oxo, thio, des radicaux 1-éthényle, 2-éthényle ou 3-propényle non substitués, monosubstitués ou disubstitués, lesdits substituants étant choisis dans le groupe constitué par l'hydrogène, les radicaux alkyle en C<sub>1</sub>-C<sub>10</sub> et aralkyle en C<sub>7</sub>-C<sub>10</sub>, des radicaux carboxy, hydroxy, amino, alkylamino en C<sub>1</sub>-C<sub>6</sub>, dialkylamino en C<sub>1</sub>-C<sub>6</sub>, des atomes halogène, ceux-ci étant définis par Cl, F, Br et I, des radicaux nitro ou cyano,

et de plus où ledit atome d'azote peut en outre être substitué pour former un ion ammonium quaternaire dans lequel ledit substituant est tel que défini au préalable pour R<sup>6</sup> et R<sup>7</sup> ;

R<sup>2</sup> et R<sup>3</sup> sont indépendamment :

l'hydrogène, un radical aryle ou un groupe cycloalkyle ou alkyle en C<sub>0</sub>-C<sub>10</sub> éventuellement substitué, ledit substituant étant :

un radical alcoxyalkyle en C<sub>1</sub>-C<sub>10</sub>, aryle, un noyau hétérocyclique à 4 à 8 chaînons contenant 1, 2, 3 ou 4 hétéroatomes, lesdits hétéroatomes étant choisis parmi l'ensemble constitué par N, O et S, un radical aralkyle en C<sub>4</sub>-C<sub>10</sub>, alcaryle en C<sub>1</sub>-C<sub>10</sub>, carboxy, alkylcarbonyle en C<sub>1</sub>-C<sub>10</sub>, alkylthiocarbonyle en C<sub>1</sub>-C<sub>10</sub>, aralkylcarbonyle en C<sub>4</sub>-C<sub>10</sub>, aralkylthiocarbonyle en C<sub>4</sub>-C<sub>10</sub>, alcoxycarbonyle en C<sub>1</sub>-C<sub>6</sub>, aralcoxycarbonyle en C<sub>4</sub>-C<sub>10</sub>, alcoxy en C<sub>1</sub>-C<sub>6</sub>, aralcoxy en C<sub>4</sub>-C<sub>10</sub>, alkylamino en C<sub>1</sub>-C<sub>6</sub>, dialkylamino en C<sub>1</sub>-C<sub>12</sub>, alcanoylamino en C<sub>1</sub>-C<sub>6</sub>, aralcanoylamino en C<sub>4</sub>-C<sub>12</sub>, aralkylamino en C<sub>4</sub>-C<sub>10</sub> ;

R<sup>4</sup> est :

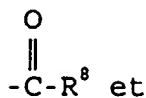
l'hydrogène, un radical aryle, cycloalkyle ou alkyle en C<sub>1</sub>-C<sub>10</sub>, aralkyle en C<sub>4</sub>-C<sub>10</sub>, arylcarbonyle, aminocarbonyle, alkylcarbonyle en C<sub>1</sub>-C<sub>10</sub>, alkylaminocarbonyle en C<sub>1</sub>-C<sub>6</sub>, alkylthiocarbonyle en C<sub>1</sub>-C<sub>10</sub>, dialkylaminocarbonyle en C<sub>1</sub>-C<sub>6</sub>, alcoxylthiocarbonyle en C<sub>1</sub>-C<sub>10</sub>, aryl-(alkyl en C<sub>1</sub>-C<sub>6</sub>) aminocarbonyle, alcoxycarbonyle en C<sub>1</sub>-C<sub>10</sub>, aralkylcarbonyle en C<sub>4</sub>-C<sub>10</sub>, aralcoxycarbonyle en C<sub>4</sub>-C<sub>10</sub>, carboxyalkyle en C<sub>1</sub>-C<sub>10</sub>, et

en outre, dans lequel l'un quelconque des substituants de R<sup>4</sup> peut être substitué par un ou plusieurs substituants choisis dans l'ensemble défini pour R<sup>6</sup>, ou par un acide L-aminé ou D-aminé réuni par une liaison amide ;

R<sup>5</sup> est :

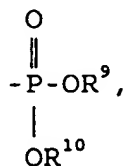
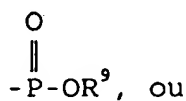
un noyau hétérocyclique saturé ou insaturé à 4 à 8 chaînons, contenant 1, 2, 3 ou 4 hétéroatomes,

lesdits hétéroatomes étant N, O ou S, ou



où  $\text{R}^8$  est un radical :

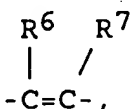
hydroxy, alkyloxy en  $\text{C}_1\text{-C}_{10}$ , alcaryloxy en  $\text{C}_1\text{-C}_{10}$ , aralkyloxy en  $\text{C}_4\text{-C}_{10}$ , aralkylcarbonyloxy en  $\text{C}_4\text{-C}_{10}$ , alcoxyalkyloxy en  $\text{C}_1\text{-C}_{10}$ , alcoxyalkylcarbonyloxy en  $\text{C}_1\text{-C}_{10}$ , alcoxycarbonyloxyalkyle en  $\text{C}_1\text{-C}_{10}$ , alkylcarbonyloxyalkyloxy en  $\text{C}_1\text{-C}_{10}$ , un acide L- ou D-aminé réuni par une liaison amide, et où le fragment acide carboxylique dudit acide aminé est sous forme acide libre ou est estérifié par un radical alkyle en  $\text{C}_1\text{-C}_6$  ;



où  $\text{R}^9$  et  $\text{R}^{10}$  sont choisis dans l'ensemble constitué par :

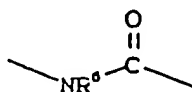
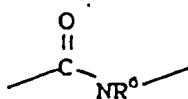
l'hydrogène et les radicaux alkyle en  $\text{C}_1\text{-C}_{10}$  et aralkyle en  $\text{C}_4\text{-C}_{10}$  ;

X et Y sont des substituants facultatifs qui, lorsqu'ils sont présents, sont :  $\text{NR}^6$ , O, S, SO,  $\text{SO}_2$ ,



$-\text{C}=\text{C}-$ , oxo, aryle, thiono,

un radical cycloalkyle ou alkyle en  $\text{C}_1\text{-C}_{15}$  éventuellement substitué, lesdits substituants étant indépendamment  $\text{R}^6$  et  $\text{R}^7$ ,

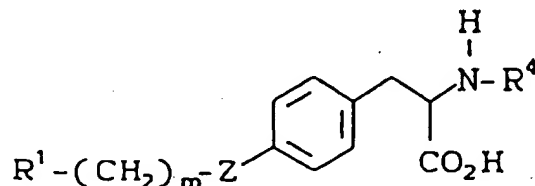


$-\text{NR}^6\text{-SO}_2-$ ,  $-\text{SO}_2\text{-NR}^6-$ , ou un noyau hétérocyclique à 4 à 8 chaînons contenant 1, 2, 3 ou 4 hétéroatomes, lesdits atomes étant N, O ou S, et ledit noyau étant indépendamment substitué, au niveau d'un atome quelconque, par  $\text{R}^6$  ;

Z est un substituant facultatif qui, lorsqu'il est présent, est choisi indépendamment parmi les définitions données pour X et Y ;

m est un entier de 0 à 10 ;  
 n est un entier de 0 à 10 ; et  
 p est un entier de 0 à 3.

7. Utilisation d'un composé selon la revendication 6, pour la fabrication d'un médicament pour la prévention ou le traitement de la formation de thrombus et d'embolies.
8. Utilisation d'un composé selon la revendication 6, pour la fabrication d'un médicament pour inhiber l'agrégation des plaquettes sanguines.
9. Utilisation d'un composé selon la revendication 6, ensemble avec un anticoagulant, pour la fabrication d'un médicament pour la prévention ou le traitement de la formation de thrombus ou d'embolies.
10. Utilisation d'un composé selon la revendication 6, ensemble avec un anticoagulant, pour la fabrication d'un médicament pour inhiber l'agrégation des plaquettes.
11. Utilisation d'un composé selon la revendication 6, ensemble avec un agent thrombolytique, pour la fabrication d'un médicament pour la prévention ou le traitement de la formation de thrombus et d'embolies.
12. Utilisation d'un composé selon la revendication 6, ensemble avec un agent thrombolytique, pour la fabrication d'un médicament pour inhiber l'agrégation des plaquettes sanguines.
13. Utilisation d'un composé selon la revendication 6, ensemble avec un inhibiteur plaquettaire, pour la fabrication d'un médicament pour la prévention ou le traitement de la formation de thrombus et d'embolies.
14. Utilisation d'un composé selon la revendication 6, ensemble avec un inhibiteur plaquettaire, pour la fabrication d'un médicament pour inhiber l'agrégation des plaquettes sanguines.
15. Composition pharmaceutique, comprenant un composé selon la revendication 6 et un véhicule acceptable en pharmacie.
16. Composition pharmaceutique, comprenant un composé selon la revendication 6, un véhicule acceptable en pharmacie et un composé choisi parmi l'ensemble constitué par les agents thrombolytiques, les inhibiteurs plaquettaires et les anticoagulants.
17. Composition selon la revendication 15 ou 16, dans laquelle ledit véhicule acceptable en pharmacie est constitué d'une formulation pharmaceutique à libération prolongée.
18. Composés selon la revendication 6, destinés à être utilisés pour inhiber la fixation du fibrinogène aux plaquettes sanguines, pour inhiber l'agrégation des plaquettes sanguines, pour traiter la formation de thrombus ou la formation d'embolies, ou pour empêcher la formation de thrombus ou d'embolies chez un mammifère.
19. Composés selon la revendication 5, destinés à être utilisés pour inhiber la fixation du fibrinogène aux plaquettes sanguines, pour inhiber l'agrégation des plaquettes sanguines, pour traiter la formation de thrombus ou la formation d'embolies, ou pour empêcher la formation de thrombus ou d'embolies chez un mammifère.
20. Composé selon la revendication 1, de formule :



dans laquelle

R<sup>1</sup> est :  
un noyau hétérocyclique à 5 ou 6 chaînons dans lequel ledit hétéroatome est N et ledit noyau hétérocyclique est éventuellement substitué par l'hydrogène ou un radical alkyle en C<sub>1</sub>-C<sub>5</sub> ; ou NR<sup>6</sup>R<sup>7</sup>, où R<sup>6</sup> et R<sup>7</sup> sont indépendamment l'hydrogène ou un groupe arylalkyle en C<sub>4</sub>-C<sub>10</sub> ou alkyle en C<sub>1</sub>-C<sub>10</sub> ;

R<sup>4</sup> est :  
un radical arylcarbonyl, alkylcarbonyl en C<sub>1</sub>-C<sub>10</sub>, alcoxycarbonyl en C<sub>1</sub>-C<sub>10</sub>, aralkylcarbonyl en C<sub>4</sub>-C<sub>10</sub>, ou aralcoxycarbonyl en C<sub>4</sub>-C<sub>10</sub>,  
où R<sup>4</sup> est éventuellement substitué par R<sup>6</sup>, tel que défini au préalable ;

Z est choisi parmi O, -NR<sup>6</sup>CO-, -CONR<sup>6</sup>, et CH<sub>2</sub> ; et

m est un entier de 0 à 6 ;

à l'exception de :

la N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine,

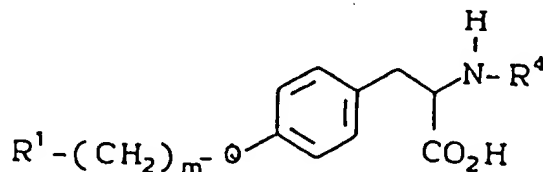
la N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine,

la N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminopropyl)-L-tyrosine, et

l'acide α-benzoylamino-4-(2-diéthylaminoéthoxy)benzènepropanoïque.

#### Revendications pour les Etats contractants suivants : ES, GR

##### 1. Procédé pour la préparation d'un composé de formule :



ou d'un de ses sels acceptables en pharmacie, formule dans laquelle :

R<sup>1</sup> est :  
un noyau hétérocyclique à 5 ou 6 chaînons dans lequel ledit hétéroatome est N et ledit noyau hétérocyclique est éventuellement substitué par l'hydrogène ou un radical alkyle en C<sub>1</sub>-C<sub>5</sub> ; ou NR<sup>6</sup>R<sup>7</sup>, où R<sup>6</sup> et R<sup>7</sup> sont indépendamment l'hydrogène ou un groupe arylalkyle en C<sub>4</sub>-C<sub>10</sub> ou alkyle en C<sub>1</sub>-C<sub>10</sub> ;

R<sup>4</sup> est :  
un radical arylcarbonyl, alkylcarbonyl en C<sub>1</sub>-C<sub>10</sub>, alcoxycarbonyl en C<sub>1</sub>-C<sub>10</sub>, aralkylcarbonyl en C<sub>4</sub>-C<sub>10</sub>, ou aralcoxycarbonyl en C<sub>4</sub>-C<sub>10</sub>,  
où R<sup>4</sup> est éventuellement substitué par R<sup>6</sup>, tel que défini au préalable ; et

m est un entier de 0 à 6 ;

à l'exception de :

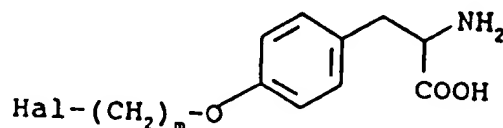
la N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine,

la N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine,

la N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminopropyl)-L-tyrosine, et

l'acide α-benzoylamino-4-(2-diéthylaminoéthoxy)benzènepropanoïque ;

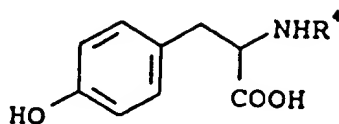
qui consiste à faire réagir un composé de formule :



ou un de ses dérivés protégés, où Hal est un atome d'halogène, avec un composé de formule R<sup>1</sup>-H ;  
puis, si nécessaire, à éliminer tout groupe protecteur présent.

2. Procédé selon la revendication 1, qui consiste :

1) à faire réagir un composé de formule :

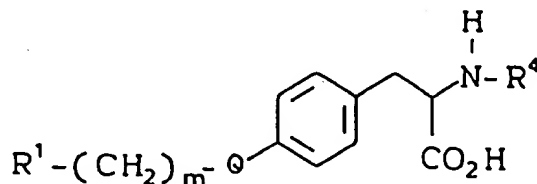


ou un de ses dérivés protégés, avec un composé de formule  $\text{Hal}-(\text{CH}_2)_m-\text{Hal}$ , où Hal est un atome d'halogène, en présence d'une base ; et

2) à faire réagir le produit de l'étape 1) avec un composé de formule  $\text{R}^1-\text{H}$  ;

puis, si nécessaire, à éliminer tout groupe protecteur présent.

3. Procédé pour la préparation d'un composé de formule :



ou d'un de ses sels acceptables en pharmacie, formule dans laquelle :

$\text{R}^1$  est :

un noyau hétérocyclique à 5 ou 6 chaînons dans lequel ledit hétéroatome est N et ledit noyau hétérocyclique est éventuellement substitué par l'hydrogène ou un radical alkyle en  $\text{C}_1-\text{C}_5$  ; ou  $\text{NR}^6\text{R}^7$ , où  $\text{R}^6$  et  $\text{R}^7$  sont indépendamment l'hydrogène ou un groupe arylalkyle en  $\text{C}_4-\text{C}_{10}$  ou alkyle en  $\text{C}_1-\text{C}_{10}$  ;

$\text{R}^4$  est :

un radical arylcarbonyl, alkylcarbonyl en  $\text{C}_1-\text{C}_{10}$ , alcoxycarbonyl en  $\text{C}_1-\text{C}_{10}$ , aralkylcarbonyl en  $\text{C}_4-\text{C}_{10}$ , ou aralcoxycarbonyl en  $\text{C}_4-\text{C}_{10}$ ,

où  $\text{R}^4$  est éventuellement substitué par  $\text{R}^6$ , tel que défini au préalable ; et

m est un entier de 0 à 6 ;

à l'exception de :

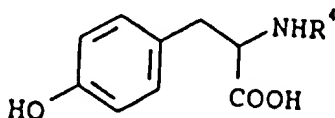
la N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine,

la N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine,

la N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminopropyl)-L-tyrosine, et

l'acide  $\alpha$ -benzoylamino-4-(2-diéthylaminoéthoxy)benzèneprépropanoïque ;

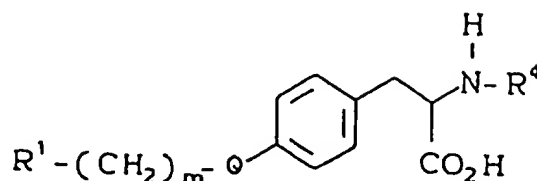
qui consiste à faire réagir un composé de formule :



ou un de ses dérivés protégés, avec un composé de formule  $\text{R}^1-(\text{CH}_2)_m-\text{Hal}$  ou un de ses dérivés protégés, où Hal est un atome d'halogène, en présence d'une base ;

puis, si nécessaire, à éliminer tout groupe protecteur présent.

## 4. Procédé pour la préparation d'un composé de formule :

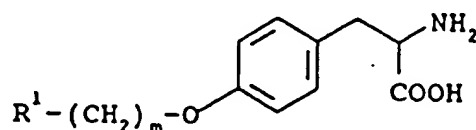


ou d'un de ses sels acceptables en pharmacie,  
formule dans laquelle :

- $R^1$  est :  
un noyau hétérocyclique à 5 ou 6 chaînons dans lequel ledit hétéroatome est N et ledit noyau hétérocyclique est éventuellement substitué par l'hydrogène ou un radical alkyle en  $C_1-C_5$  ; ou  $NR^6R^7$ , où  $R^6$  et  $R^7$  sont indépendamment l'hydrogène ou un groupe arylalkyle en  $C_4-C_{10}$  ou alkyle en  $C_1-C_{10}$  ;
- $R^4$  est :  
un radical arylcarbonyle, alkylcarbonyle en  $C_1-C_{10}$ , alcoxycarbonyle en  $C_1-C_{10}$ , aralkylcarbonyle en  $C_4-C_{10}$ , ou aralcoxycarbonyle en  $C_4-C_{10}$ ,  
où  $R^4$  est éventuellement substitué par  $R^6$ , tel que défini au préalable ; et
- $m$  est un entier de 0 à 6 ;

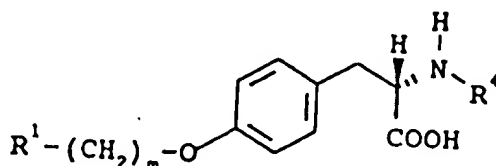
à l'exception de :

la N-tert-butoxycarbonyl-O-(3-phthalimidopropyl)-L-tyrosine,  
la N-tert-butoxycarbonyl-O-(3-aminopropyl)-L-tyrosine,  
la N-tert-butoxycarbonyl-O-(3-tert-butoxycarbonylaminopropyl)-L-tyrosine, et  
l'acide  $\alpha$ -benzoylamino-4-(2-diéthylaminoéthoxy)benzènepréanoïque ;  
qui consiste à faire réagir un composé de formule :



ou un de ses dérivés protégés, avec un composé de formule  $R'\text{CO}_2\text{H}$  ou un de ses dérivés acyl-halogénés activés (où  $R'$  est un radical aryle, alkyle en  $C_1-C_{10}$ , alcoxy en  $C_1-C_{10}$ , aralkyle en  $C_4-C_{10}$  ou aralcoxy en  $C_4-C_{10}$ , chacun d'entre eux pouvant être éventuellement substitué par  $R^6$  tel que défini au préalable) ;  
puis, si nécessaire, à éliminer tout groupe protecteur présent.

## 5. Procédé selon l'une quelconque des revendications 1 à 4, pour la préparation d'un composé de formule :



dans laquelle  $R^1$ ,  $R^4$  et  $m$  sont tels que définis dans la revendication 1 ;  
ou d'un de ses sels acceptables en pharmacie.

## 6. Procédé selon l'une quelconque des revendications 1 à 4, pour la préparation d'un composé choisi dans l'ensemble constitué par :

l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(3-N-pyrrolidinylpropyloxy)phényl]propionique ;  
l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(4-pipérazinyl)butyloxyphényl]propionique ;  
l'acide 2-S-(N-benzyloxycarbonyl)-3-[4-(4-méthylpipérazine-1-yl)propyloxyphényl]propionique ;  
l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(4-pipérazine-1-yl)pentyloxyphényl]propionique ;  
l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(4-pipéridinylbutyloxy)phényl]propionique ;  
l'acide 2-S-(N-benzyloxycarbonylamino)-3-[4-(4-pipéridinyl)-but-2-ényloxyphényl]propionique ;  
le chlorhydrate de l'acide 2-S-(pentanoylamino)-3-[4-(4-pipéridine-4-ylbutyloxy)phényl]propionique ;  
l'acide 2-S-(hexanoylamino)-3-[4-(4-pipéridine-4-yl-butyl)oxyphényl]propionique ;  
et leurs sels acceptables en pharmacie.

